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Forthcoming Events.

MARCH 5.

British Foundrymen's Association (Manchester Branch).—"The Production of Castings to withstand Hydraulic Pressure," by E. L. Rhead, F.I.C., F.C.S.

MARCH 12.

British Foundrymen's Association (Birmingham Branch)—"Moulding Sands," by J. Shaw.

MARCH 26.

British Foundrymen's Association (Sheffield Branch).—"Some Mechanical Patterns in Repetition Work," by G. Buchanan.

NOTES AND COMMENTS.

The Selling of Pig-Iron by Analysis.

The resolution adopted by the British members of the International Association for the Testing of Materials last month, to the effect that the conditions governing the sale of pig-iron in Great Britain make it undesirable to recommend any immediate change in the existing practice of grading, whether by fracture or analysis, will not cause any great surprise, even amongst the most ardent advocates of scientific methods. The difficulties in the way of selling on the basis of analysis were well pointed out by the speakers at the meeting; and even though the statement of Mr. Donaldson, as representing the Scotch Pig-iron Trade Association, may be taken by many foundrymen as the outcome of prejudice and self-interest, the dictum of such enthusiastic supporters of technical and scientific advancement as Mr. J. E. Stead and Mr. H. Pilkington cannot be disregarded. Not the least important point was that brought out by Mr. Stead, who stated that if analysis were substituted for fracture appearance it would be necessary to analyse almost every pig bed, which would greatly interfere with the present practice of putting iron into store. He admitted, however, that the change from selling by fracture to selling by analysis was being gradually, if slowly, effected. Mr. Pilkington contributed to the discussion an address on the subject which he delivered last year before the Sheffield Branch of the British Foundrymen's Association, and offered some important suggestions. The crystallisation, or grain, in pig-iron or castings, which is produced as a result of certain heat conditions, to a very large extent has proved the necessity and value of grading pig-iron by fracture, although it is a somewhat crude method when the classification is done by numbers alone. There has not yet been suggested a chemical specification that is free from some practical objection or other, and when, as frequently is the case, the commercial elements of the situation are disregarded, the trader cannot be expected to receive the innovation with open arms. Classification by fracture will probably not be wholly abandoned until some method of physical or microscopical classification is introduced to replace it. This will not entail any abandonment of chemical analysis to complete the classification, but will rather be its aid. There is much to be said for Mr. Pilkington's suggestion that the present method of grading by fracture numbers be continued and the pigs be sold on their silicon contents for that particular number. Most foundrymen, while appreciating the difficulties in the way of any alteration to the existing system, will proba regard the assertion of the representative of the Staffordshire Iron and Steel Institute that it was possible to get at the analysis from the fracture, as rather optimistic. When also Mr. Hutchinson, of the Cleveland Ironmasters' Association, claims that for the past 60 years the present method has been found absolutely effective, the foundryman is tempted to ask whether from the makers' or the

users' standpoint. The foundryman has certainly submitted to the existing method, but if it is absolutely effective, whence the outcry for a change? When the foundryman is told that he has followed in a certain line in the past he might well reply, "Needs must when the devil drives." At present, then, the position appears to be that the user of pig-iron, since he cannot buy to analysis without paying a considerably higher price, must investigate on his own account the character of the different irons he uses, and, after ascertaining their respective values from his point of view, purchase accordingly. This, of course, does not allow for variations in different consignments of the same brand; where the work justifies it the best course to follow is to mix the metal for the cupola according to some such system as that outlined by Mr. Hailstone in his Paper on "The Scientific Mixing of Iron for Castings." But apart from the immediate procedure, a step towards the solution of the problem will be made when our foundrymen come to agree on some form of general specification.

Carborundum in the Foundry.

In an article on another page mention is made of the application of carborundum to the making of moulds for casting aluminium. Carborundum is perhaps best known in its application to abrasive purposes, for it was in the grinding shop that it first attracted attention on account of its extreme hardness. But carborundum—carbide of silicon, as its correct name is—besides being particularly applicable to grinding and abrasive purposes, has a large field of usefulness as a refractory material. In fact, it is a refractory material of extraordinary qualities, being produced from silicon and carbon, two of the most refractory materials known to the metallurgist, at a temperature where the purest fire clays exist only as vapours. On account of its superior heat-resisting qualities it is coming to have a wide application in the lining of furnaces subject to extreme temperatures and severe flame action, though, of course, it cannot compete with the fire-resisting substances now used in general furnace work, on account of the cost. The form of carborundum most commonly employed in refractory work is called carborundum fire sand. This is an amorphous form of carborundum containing silicon, oxygen and carbon in the form of various compounds representing the partial reduction of silicon by carbon at the intense heat of the electric furnace. Carborundum fire-sand is furnished to the trade in the form of a finely ground sand, and is mixed before using with a binding material such as silicate of soda or fire clay, to give it proper cohesion when brought up to heat.

This fire-sand is perhaps the best refractory material of the brass foundry. In the lining of the ordinary type of crucible brass furnace a mixture is made consisting of 70 parts of carborundum fire-sand, 15 parts of ground fire clay, 8 parts of 52-degree silicate of soda and 7 parts of water. These ingredients are thoroughly blended until they acquire the consistency of moulding sand and form a plastic mixture which can be moulded or tamped in position to form the lining of the furnace, entirely replacing fire brick. In oil furnace work carborundum fire-sand gives a life far exceeding the best fire brick, In the various types of tilting and rotary furnaces for melting brass with oil fuel, the linings are subjected to very severe flame conditions, and carborundum linings have shown in such locations a life of from 200 to 600 heats.

Carborundum furnace paint is also used as a protective coating for furnaces subjected to intense flame action and high temperature. It is preferably applied to new brick work, as it does not adhere so effectively after linings have been glazed over or covered with slag. Carborundum furnace paint is found very applicable to welding furnaces, malleable iron furnaces, and various types of oil furnaces, and is also used with good results as a cupola wash in protecting the melting zone of foundry cupolas, while mortar composed of one-half carborundum fire-sand and one-half fire clay is an excellent material for laying up fire brick. The same mixture may be used for ladle linings and general repairs in patching furnace walls. Carborundum bricks are made in all sizes, and have special application in copper reverberatory furnaces and various other types of furnaces subjected to high temperatures.

Another application of carborundum is in the casting of aluminium and various bronze alloys where it can be used in place of moulding sand, and is said to increase the tensile strength of the casting from 50 to 100 per cent. This action is due to the high heat conductivity of the carborundum mould, which has the effect of rapidly chilling the metal and preventing segregation of the constituents of the alloy. In the manufacture of steel its chemical properties early brought carborundum to the attention of metallurgists as a ready source of silicon and carbon. When used in open-hearth practice, it is supplied in the form of powder containing 62 per cent. available silicon, and is added directly to the ladle during the tapping, being readily dissolved in the molten metal. Carbide of silicon acts as a powerful deoxidising agent, increasing the fluidity and temperature of the metal.

Foundrymen's Association for Glasgow.

We are informed by the Secretary of the British Foundrymen's Association that a Branch of that body is being formed in Glasgow for members residing in Scotland. The Council of the Association will be obliged if those interested in the foundry and its allied industries in Scotland will communicate with Mr. J. A. Ewen, San Rafael Cottage, Burnbank, Hamilton, who has been appointed local secretary *pro tem.* We are pleased to note that the Association is sufficiently strong north of the Tweed to warrant the formation of a Scottish Branch. The foundry in Scotland has played, and is still playing an important part in the industrial life of the nation; in fact, the work turned out by Scottish foundrymen in the pipe and column casting section of the trade has been the despair and envy of Continental founders. The distinctions that once existed between the craftsmen of North and South Great Britain, however, are gradually becoming lost through inter-communication and the mingling of the craftsmen from different districts. But there are probably many points of difference in daily foundry practice, which if explained would result in mutual benefit. There are in Scotland over three hundred and fifty foundries of more or less importance, making iron, or iron and brass castings, as well as about fifty others casting only brass and similar metals (these do not include very small and unimportant shops, of which we have no record), so that there should be plenty of material available for a most flourishing Glasgow Branch of the British Foundrymen's Association. Glasgow alone possesses over fifty iron foundries and at least fifteen brass foundries of some importance, which alone should give a splendid field to draw recruits from. Nor do we think that Glasgow will be slow to take advantage of the new organisation, for the Celtic shrewdness is certain to quickly perceive the advantages to be gained by association with such an educative body.

The Selling of Pig-Iron.

British Manufacturers and the Proposed Change.

It will be remembered by those interested that a good deal of discussion took place at the recent Congress at Copenhagen of the International Association for the Testing of Materials, on a proposal put forward by American and German representatives that sales of pig-iron should in future be based on analysis, and not on the grading by fracture which has for so many years been the method adopted for sales in bulk in this country. The actual terms of the resolution finally passed at Copenhagen in September were :—"That for the purpose of defining more accurately the quality of pig-iron than is possible by the present method of grading by fracture appearance, the Congress recommends that the Committee be instructed to enquire, in the various countries concerned, as to how far specification by analysis can be usefully substituted for the grading by fracture appearance."

As the outcome of this resolution, a meeting was held on Thursday, February 10, in the Council Room of the Iron and Steel Institute, of the British members of the International Association and representatives of Associations interested in a proposal which in its full significance would be destined, if accepted by British manufacturers, to have far-reaching consequences.

Mr. J. E. Stead, F.R.S., who represented the Iron and Steel Institute and the Cleveland Institution of Engineers, occupied the chair, and those present included: Mr. T. C. Hutchinson (Cleveland Ironmasters' Association), Mr. H. Pilkington (British Foundrymen's Association), Mr. W. J. Foster (Staffordshire Iron and Steel Institute), Mr. W. H. Butlin (British Iron Trade Association), Mr. C. J. Fairfax Scott (Secretary, British Iron Trade Association), Mr. G. Roberts (Woolwich Arsenal), Mr. Charles Dressler (Engineering Standards Committee), Dr. Walter Rosenhain (National Physical Laboratory), Mr. H. J. Skelton, Mr. G. T. Holloway, Mr. Adamson (Sheffield), and Mr. F. E. Robertson, with Mr. G. F. Lloyd (British Member of Council of the International Association).

Mr. Peter Donaldson, in a written communication, as the representative of the Scotch Pig-iron Trade Association, said that his opinion on the question of grading pig-iron was that analysis was the correct way to do it, and that in the long run it would come to that. He considered, however, that we were very far from arriving at that point in Great Britain, and questioned very much whether either makers or consumers, as things stood at present, would agree to alter the old method of grading by fracture. Great Britain in all such matters was a very conservative country, and he was afraid we must allow America and Germany to move a little further on these lines before attempting to get the bulk of the people in the trade here to alter.

Mr. H. Pilkington also submitted a written communication. In this he pointed out that so far as the subject of foundry pig-iron was concerned, the circumstances of America and Great Britain were widely different. Practically the whole of the foundry pig-irons in America were made from hematites of one class or another, while those of this country had nothing whatever to do with hematites. From the point of view of a pig-iron maker he had carefully considered specifications produced by American Associations, but they had little application on this side of the water. To a very large extent scientific research had proved the necessity and value of grading pig-iron by fracture, but after all that was a somewhat crude method when the classification was done by numbers alone. It was evident, therefore, that some improved method of grading was in every way desirable, seeing that fracture of itself was an unreliable guide to a definite behaviour. None of the suggested chemical specifications were free from some practical objection or other, and very frequently their authors failed to appreciate the commercial elements of the situation. It was his opinion that classification by fracture could not be wholly abandoned until some method of physical or microscopical classification was introduced to replace it, which would, no doubt, be the case some day. This would not entail any abandonment of chemical analysis to complete the classification, but would rather be its aid. That time, owing to practical and commercial reasons, and also the time necessary to educate their people, was not likely to arrive within a reasonable period. It was fairly obvious, therefore, that under these several conditions the only practical step in advance which could be taken at the present time was one which was, indeed, very largely coming into vogue, viz., to continue the present method of grading by fracture numbers and sell the "pigs" on their silicon content for that particular number. The specification of silicon alone was utterly useless for the purpose of grading foundry pig-irons, as were also the specifications of silicon and sulphur without the fracture grade. Innumerable instances of this might be quoted, but perhaps the best illustration was that of the material known as glazed or silky forge pig-iron, which contained a high percentage of sulphur as well as silicon. This was occasionally produced at blast furnaces when the percentage of lime used for fluxing was inadequate, due to variations in the lime content of the ores. On the other hand, what was known as foundry silky pig-iron, while having an extremely low percentage of sulphur had, of course, high silicon, so that it was clear that in every day practice high silicon might be present in both hard and soft irons of the same brands. Foundry iron should be graded by the percentage of silicon contained in each number as graded by fracture. Thus a selection of iron required for a particular purpose in the foundry would be made by the selection of the make of a certain district or particular brand to secure the proper amount of phosphorus and manganese required, as the constancy of these could be relied upon. The iron would be graded by fracture and that number would be sold with a definite percentage of silicon content. That appeared to him to be the rational way of dealing with this very vexed question at present, and at all events it would be the first step towards placing grading on a more satisfactory basis.

Mr. J. E. Stead, in opening the discussion, said that the conditions of trade in Great Britain were very different from those existing in America and Germany. This country, as was well known, had a larger export trade in pig-iron than any other country, and the present method of grading by fracture had worked very satisfactorily. If analysis were substituted for fracture appearance it would be necessary to analyse almost every pig bed. This would greatly interfere with the present practice of putting iron into store, and would be restrictive and hampering in other ways,

as well as raise the price of pig-iron. As a matter of fact, however, the change from selling by fracture to selling by analysis was being gradually, if slowly, effected, and this particularly applied to special consignments of pig-iron to certain places in Germany and America. He had himself analysed at Middlesbrough many lots of special high-silicon pig-iron for German consumers. British manufacturers had no objection whatever to work to a specification, provided that special arrangements were made and the price fixed to cover the extra cost. That practice was being gradually introduced, but for the general trade of the country in pig-iron it would be absolutely fatal at the present time to suggest that such a drastic charge should be made. He might add that even at the present time pig-iron was sold in this country both by fracture and analysis, as the grading by fracture was a fairly correct method of arriving at the analysis.

Mr. H. Pilkington, adding a few words to his written statement, said that so far as the manufacture of foundry pig-iron was concerned, it was not thought that the time had arrived when any departure should be made from the present practice.

Mr. T. C. Hutchinson, on behalf of the Cleveland Ironmasters' Association, reminded the meeting that for the past 60 years the present method had been found absolutely effective. The grading by fracture appearance carried with it a certain accuracy of composition. So far as iron made from Cleveland ores was concerned, the phosphorus and manganese, and perhaps the total carbon, were uniform. The varying elements were silicon and sulphur, and their presence was indicated sufficiently by fracture appearance for all practical purposes. It might be desirable in large sales of iron for steel making that there should be a special analysis, and that would no doubt come about, but the very fact that steel-makers had intermediate mixers before the material went into the steel furnace proper was an indication that there were slight variations in the iron from the blast furnace which made it necessary for the steel-maker to bring the material to the absolute uniform proportions desired. Cleveland ironmasters had no difficulty in meeting the requirements of customers by the grading method now in force. The difficulty of the analytical method in relation to iron going into store had been referred to, and it was obvious it would be inconvenient to makers and users alike. The expense of keeping the analysed lots separate would be so high that it would probably prevent iron going into store at all, and put an end to that useful method of dealing with surplus production. The Cleveland ironmasters took so strong a view of the proposal put forward that he was authorised to say they would refuse to be bound by any resolution to sell iron by analysis. He, personally, as a matter of fact, analysed the iron made, but it was analysed in bulk. It would be quite impossible when selling iron in bulk to keep small analysed lots separate. The cost would be prohibitive.

Mr. H. J. Skelton thought it would be well to consider what was the origin of the movement for sale by analysis. He believed it dated from the manufacture in America of sandless pig-iron, in which, while the analysis might be constant, the fracture represented the iron as being other than what it was. It was that difficulty which had brought in its train the suggestion of sale by analysis. Pig-iron might be broadly divided into two classes—pig-iron for ordinary purposes and special iron. As a matter of fact, and this had been pointed out by a previous speaker, but he desired to emphasise it, every parcel of pig-iron was analysed, or at least its composition was fairly well known. One difficulty, assuming that sale by analysis was agreed to, would be the question within what limits the analysis should be maintained. Some ten years ago, when there were large imports of American pig-iron into this country, there was a movement on the London Metal Exchange in the direction of creating a special form of warrant for standard iron, but the difficulties in the way were found to be too great. He dealt very largely in special pigs, and analyses were always supplied whether the iron was going to Germany or otherwise, but it was understood that the analysis was not guaranteed, or some sharp practice in rejecting the iron on small variations would be resorted to by unscrupulous customers. Any change in practice should come gradually. Ironfounders were making more use of analysis year by year. Regard should be had to the curious and complex conditions of British trade, and home manufacturers could not agree that pig-iron should be sold only by analysis.

Mr. J. E. Stead said that while the agitation for sale by analysis originated in America, it was not coincident with the introduction of sandless iron. The foundrymen found that by making their mixtures according to analysis they gained a great advantage, and they were adopting the system of buying by analysis more and more every day.

Mr. W. J. Foster (Staffordshire Iron and Steel Institute) urged that it was possible to get at the analysis from the fracture. He personally could get very near the composition in that way, if it was conducted properly. Both methods should, however, go together.

Mr. W. H. Butlin (British Iron Trade Association) said that the Association had made enquiries among their members, and there was a very strong consensus of opinion in favour of retaining the present methods of selling pig-iron. Replies had been received from manufacturers representing an annual tonnage of 1,476,000 in favour of the present method, and in favour of analysis there was a tonnage of 120,000. For steel making sale by analysis appeared to find favour, and enquiry had borne out Mr. Stead's statement that sale by analysis was making steady progress on lines due to the particular requirements of the individual purchaser. Analysis was exceedingly useful in the case of foundry irons, and on economic grounds it might in this way be possible to reduce costs by substituting an iron which under present conditions would be too costly to meet the requirements of the trade. Broadly speaking, however, the position was that grading by fracture applied to a very much larger tonnage of iron than that which called for analysis.

Mr. Stead pointed out that the customer was protected in regard to analysis by decisions in the Law Courts. It had been held that analysis must, to a certain extent, be read into contracts, so that practically in the case to which he referred, the iron was sold by analysis, and an iron which went outside the recognised limits of variation of contents might be rejected as not a good delivery.

Mr. Pilkington said that the British foundrymen did not at the present time agree in any shape or form as to a general specification.

Mr. Skelton asked if it was not the fact that in Germany, where science in the iron trade was supposed to have reached a very high level, native pig-iron could not be obtained to give the desired results, and that recourse had to be had to English pig-iron? This statement also applied to the French locomotive industry.

A long discussion ensued on the exact terms of the resolution to be proposed for the acceptance of the meeting.

Mr. Hutchinson said it was recognised that full advantage had not yet been taken of how closely analysis was revealed by fracture. Much more might be done by scientific development on existing lines. The

difficulty in the way of selection by analysis was that out of twelve beds of pig-iron not two would analyse alike.

Mr. Robertson said he never bought iron in any other way than by analysis.

Mr. Adamson pointed out that fracture was the primary method in England and analysis the secondary process.

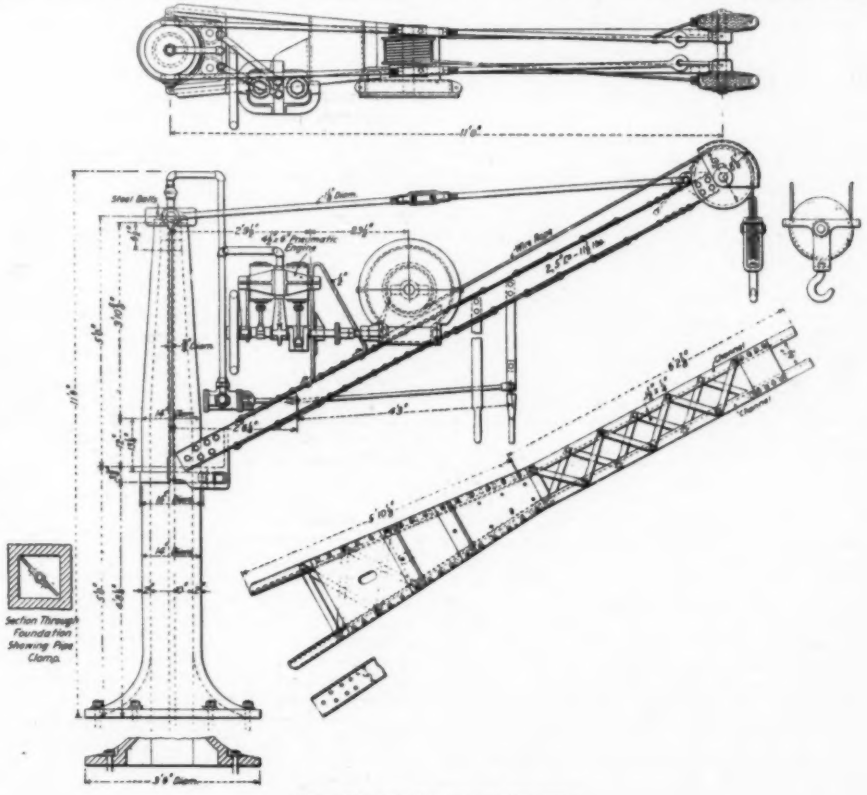
Mr. Roberts could not altogether agree that it was impossible to put iron into store by analysis.

Finally the following resolution was unanimously adopted:—"That the conditions governing the sale of pig-iron in Great Britain make it undesirable to recommend any immediate change in the existing practice of grading, whether by fracture or analysis?

This resolution will now go forward to the International Association as the expression of British opinion. Meanwhile the views of the iron trade in other countries are being obtained, and the whole subject will come up for consideration before a special meeting of the Committee of the International Association, which to be held in Brussels during the forthcoming Exhibition in that city.

A Foundry Crane.

The drawing which we present herewith shows a pneumatic foundry crane installed at the Roanoke Foundry of the Norfolk and Western Railway, which was designed and built at their shops. The apparatus is a post crane with a capacity of 3 tons. A small air engine is used as the source of power for the hoist. The post is bolted to a foundation set in the floor and the boom swings around it. The thrust of the boom is taken by a collar of the post about 5 ft. from the floor and is fitted with a roller to lower the frictional resistance in turning. The cap at the top is also provided with steel balls for the bearing for the same purpose. The boom is of 5-in. channels, with closely riveted lattice bracing, as shown.



Pneumatic Foundry Crane.

The engine is a two-cylinder air engine, with cylinders of 4½ in. diameter and 6-in. stroke, with cranks at right angles, and it is also provided with a flywheel on the crank shaft. The shaft bears a worm meshing in with a gear on the clutch of the hoisting drum which is operated by a lever shown in the side elevation. Another lever conveniently located is for manipulating the throttle so that hoisting and lowering can be done from any location. The swinging is done by pushing the load or the crane by hand. The boom is stayed by two 1¼-in. rods that can be adjusted by turnbuckles to take up any wear or working out of alignment, and the hoisting rope is of ¼-in. wire.

Large Steel Castings in Transit.

Some of the heaviest consignments which have yet been dealt with on any British railway are represented in the annexed illustrations, one of which shows the lower part of the cast-steel stern frame for one of the new White Star steamships "Olympic" and "Titanic" loaded for transit. These steamships, both of which are now under construction at Messrs. Harland & Wolff's shipbuilding yard, Belfast, will eclipse the new Cunarders in point of size, and will, therefore, be the largest ever constructed. While the total weight of the stern frame, rudder, and brackets of the "Lusitania" and "Mauretania" was in each case 220 tons, the total weight of the castings in each of the new White Star liners aggregates 290 tons.

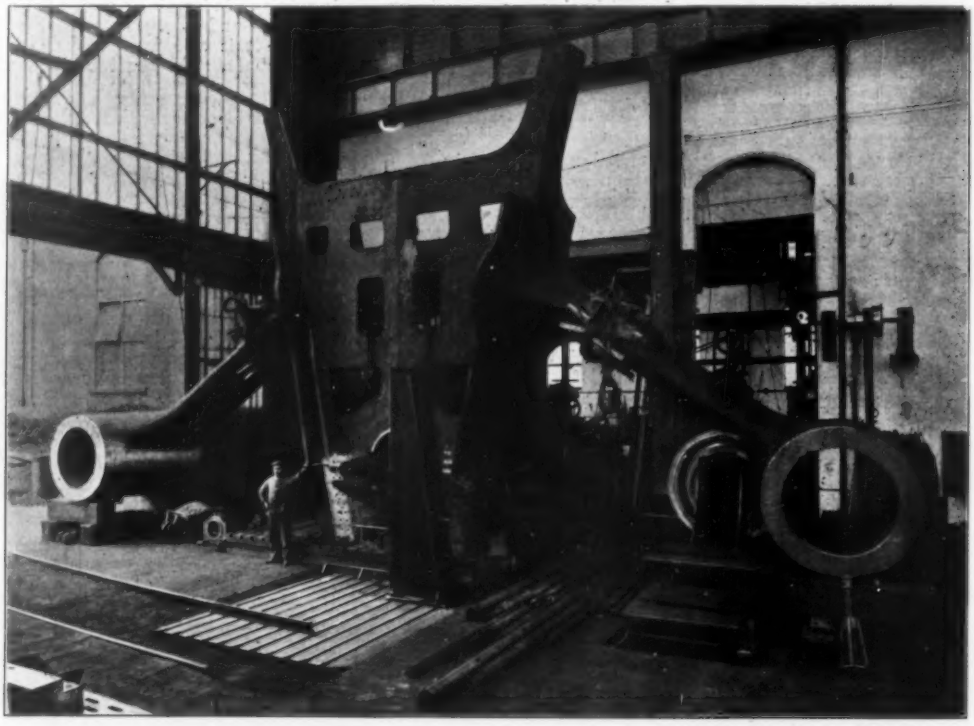


FIG. 1.—THE AFTER SHAFT BRACKETS OF THE "OLYMPIC" WHITE STAR LINER.

The photograph was taken while the parts were in course of transit recently from the Darlington Forge Company's works to West Hartlepool, where the articles were shipped for Belfast. For the purpose of transport the stern frame, which had a weight of 70 tons, had to be built in two pieces, which will be bolted together with strong flanges at the centre line of the vessel. The upper part of the stern post, when loaded on the 50-ton trolley wagon, had a total length of 63 ft., while the tail piece was 56 ft. in length. The load stretched 16 ft. 3 in. from one side, and 2 ft. 9 in. from the other side of the wagon, while the overhang had a height from rail level of 9 ft. 6 in. The lower part of the stern frame was 37 ft. 4 in. in length, and the length of the gudgeon was 16 ft., while the palm was 9 ft. wide and 11 ft. deep. When loaded for rail transport, the total overhang was 11 ft. 10 in., measured from the centre of the wagon. Both these stern frames—like those for the Cunarders—were manufactured by the Darlington Forge Company, and composed of special quality mild cast steel of hollow or "dished" section. The scarphs have been so arranged that in the event of any damage occurring to the post it can be removed with a minimum of trouble and without disturbing the riveting in any portion of the shell plating of the vessel. Special care was paid to the design of the scarphs, the forward one being of a somewhat novel construction owing to the "dishing" of the boss in its vicinity. The boss arms were also in two pairs. The two pieces forming the after boss arms were loaded upon 40-ton and 50-ton trolley wagons respectively. These castings had each a length of 22 ft., while the boss measured 6 ft. 3½ in. in depth and 5 ft. 2¼ in. in diameter. The wells of the wagons were built up with heavy timbers, and 8-ton steel ingots served as counterbalancing weights. In these instances, although the castings were loaded at an angle, the overhang from the wagon sides was 15 ft. and 2 ft. 6 in. Each of the forward boss arms had a length of 22 ft. 3 in., and the boss measured 3 ft. 6½ in. in depth and 6 ft. 2 in. in diameter.

Owing to these exceptional dimensions, and the enormous weight of the castings, elaborate arrangements were necessary for the transport of the pieces from Darlington to the shipping point, and this was only possible during the lull of traffic on a Sunday and by observing a maximum speed of less than five

miles per hour. The stern frame "special" left Darlington immediately after dawn, and the shipping point was reached shortly before evening. Accompanying the train was a 25-ton steam break-down crane, which was brought into requisition for adjusting the load at various places in order to pass certain obstructions, such as signal wires and posts, and overhead bridges. The running of this special train was only possible by the temporary alteration of the existing Sunday train service between Darlington and West Hartlepool.

On two recent Sundays also there have been successfully transported from the Openshaw Works of Sir W. G. Armstrong, Whitworth & Company, Limited, Manchester, to the Middlesbrough docks, for shipment to Japan, two exceptionally heavy castings. Although each of these castings had the unusual weight of 77 tons, they were each loaded upon one of the Great Central Railway Company's 50-ton trolley wagons, and the excess weight was distributed over two other vehicles by means of the cantilever arrangement illustrated in the accompanying photograph. The leverage was worked by means of a number of oak beams attached at one end of the vehicle carrying the load, and at the other end heavy weights were suspended and swung over small well trolleys without being in any way attached thereto. The counterbalance weight at each end was 9 tons 6 cwts. 2 qrs., and the oak beams were each 2 ft. square cross-section, and each of the sets had an approximate weight of about 11 tons. The levers were not equally placed on the wagons carrying them, and the leverage was assisted by the greater length being extended over the small trolleys at each end. In addition to the load on the beam-carrying wagons, there were 5 tons of packing, making a total load of 82 tons, so that a weight of 16 tons was required to be taken off each bogie. The beams were carried on two armour-plate wagons, each of 40 tons capacity.

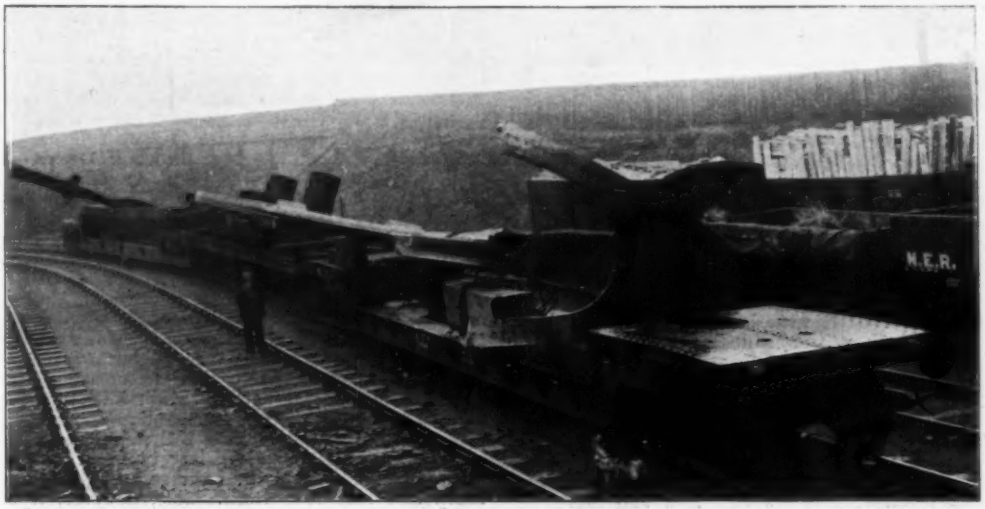


FIG. 2.—LOWER PART OF ONE OF THE STERN FRAMES OF THE NEW WHITE STAR ATLANTIC LINERS, LOADED ON WAGONS FOR RAIL TRANSPORT.

The adoption of this cantilever arrangement is a perfectly safe one; by its use some few years ago, a casting 90 tons in weight was safely transported from the Openshaw Works to Liverpool. The detailed arrangements for loading and transporting these two Japanese castings were carried out by Mr. G. J. Gibson, the Manchester District Superintendent of the Great Central Railway, acting in conjunction with the Traffic Department of the North-Eastern Railway.

FIG. 3.—LARGE CASTING (77 TONS) BEING TRANSPORTED BY RAIL UNDER THE CANTILEVER SYSTEM.

Steel Foundry Practice.*

By Percy Longmuir.

In a Paper read before this Association in 1899, Mr. Fletcher dealt with some characteristic features of steel castings. In that Paper two vital points were emphasised. The shrinkage of steel and the importance of design in meeting this shrinkage. Carried to a logical conclusion, attention to these two points will result in the production of a casting free from defect due to the unequal distribution of metal. In the present Paper the author proposes to take a survey of Steel Foundry Practice, touching generally on the processes followed, and alluding to some of the difficulties met in the conduct of these processes. Steel castings are the product of—(1) Crucible furnaces; (2) the open-hearth furnace; (3) the Bessemer converter and its modifications; (4) the electric furnace. Steel castings are not produced from cupola metal and malleable annealing ovens. Enthusiasts sometimes foretell the replacement of grey iron and malleable castings by those of steel, but considerable advances are necessary before this occurs. Grey iron, malleable iron and steel respectively fill fields of usefulness which do not admit of ready replacement.

Steel is not a term admitting of ready definition, but for the sake of simplicity may be regarded as iron associated with a certain amount of carbon. As this description covers cast iron and malleable cast iron, it may be well to take as a starting point a few typical mechanical properties.

TABLE I.—*Analysis and Mechanical Properties of Iron-Carbon Alloys.*

Material.	Combined Carbon.	Graphite.	Si.	Mn.	Sul.	Ph.	Max. Str. in tons per sq. in.	Elongation per cent. on 2in.	Redn. of Area per cent.
Pure Commercial Iron	0.08	—	0.04	0.06	0.03	0.01	18.5	35.0	52.2
Steel	0.28	—	0.15	0.29	0.06	0.05	28.0	33.5	45.6
„	0.29	—	0.07	0.16	0.07	0.06	27.2	24.0	32.3
„	0.56	—	0.22	0.89	0.02	0.02	29.2	18.5	18.0
„	0.51	—	0.11	0.42	0.06	0.05	35.4	22.5	27.0
White Iron	3.40	—	0.39	0.05	0.02	0.02	12.1	—	—
„ Annealed ...	0.20	3.2	0.39	0.05	0.02	0.02	29.2	3.5	—
Grey Iron	0.52	3.4	1.78	0.28	0.04	0.27	14.1	—	—
„	0.50	3.2	1.75	0.50	0.05	1.20	12.0	—	—

These results are selected from a series of tests by the author; with the exception of the first, they represent commercial metals cast in sand moulds, the pure iron and the steels are annealed, the white iron and grey iron are in the cast condition. The iron and steel members of this group possess more or less ductility, the white iron and grey iron will neither stretch nor bend, whilst the annealed white iron occupies an intermediate position. Hardness is to some extent a function of the amount of combined carbon, hence the steel casting containing 0.51 per cent. combined carbon and giving an elongation of 22.5 per cent. when under the tool, possesses a similar hardness to the grey irons.

The fundamental principles of moulding do not vary for cast iron, brass, or steel. Whilst principles are common, details necessarily vary to suit the particular grade of metal entering the mould. A consideration of general principles can be omitted, but a few words are necessary as to modifications imposed on the mould when the fluid entering it is molten steel. When compared with grey iron, steel has a distinctly higher initial heat, a very narrow range of fluidity and a greater contraction co-efficient: these features are responsible for the differences in detail between cast iron and steel foundry practice.

The high initial temperature of steel demands a very refractory facing for the mould, *i.e.*, a facing high in silica. The greater portion of steel moulding represents dry sand work, *i.e.*, the moulds are dried before pouring. When a natural sand is used a grade high in silica is selected, and any deficiency in bond is supplied by clay admixture. Many of the facings represent made-up compositions, and, as a rule, these consist of burnt refractory material ground to the required fineness and mixed with various binding agents. High initial temperature is therefore met by increased refractoriness in the mould. The narrow range of fluidity is met by suitable adjustment of gates in order that the mould shall fill quickly and the resulting casting be sharp and true to pattern. This, however, is only one aspect of the limited range of fluidity and a greater one lies in its effect on liquid shrinkage.

Shrinkage and contraction are terms often used with loose freedom. "Technically, shrinkage refers to the gradual lessening in volume of fluid metal as it approaches the solidification point at which shrinkage ceases and contraction commences, contraction being understood to refer to the lessening in length or in volume of the solid metal."*

Liquid shrinkage cannot readily be measured, but this shrinkage must be met if a solid casting is desired. Grey iron having a comparatively long interval of fluidity, liquid shrinkage may be met by means of normal feeding heads. These heads are artificially kept open by the aid of a feeding rod, and thereby offer a means of supplying the natural shrinkage of the solidifying casting. The narrow range of fluidity familiar to steel practically precludes the use of feeding rods. Shrinkage must therefore be met entirely from the feeding heads. This fact necessitates the use of much heavier feeders than would be employed on the same casting if made in grey iron. Whether one or more heads are employed is determined entirely by the contour of the casting. In plain, bulky work one central feeder may be effective, but in other cases it may be necessary to split the one feeder into several units, each having a local effect. The feature of moment is that the shrinkage of steel is high and quick in action; the measures adopted must therefore be such as will promptly supply the demands of the rapidly shrinking fluid. In many cases this will necessitate feeding heads of a volume equal to a third of that of the casting produced.

The period of liquid shrinkage is followed by solid contraction and this phase introduces some little details demanding special provision. Under normal conditions steel castings will give a contraction of $\frac{7}{16}$ in. per foot of length, thus a steel liner 20 ft. long will give a total contraction of $3\frac{3}{4}$ ins. If the

* Read, February 26th, 1910, before the Manchester Association of Engineers.

* "General Foundry Practice." Mc.William and Longmuir.

liner is provided with end flanges then each flange must travel towards the centre a distance of 1¼ in. and if the character of the mould will not permit this movement then fracture will occur or inherent weakness be developed. The art of the steel moulder is therefore shown in his efforts to meet this contraction. In many cases rigid moulds are essential in order to resist fluid pressure and the well-known resources of the iron moulder, yielding coke beds and the like—are not always applicable.

In such cases the mould must be eased, when the casting has just solidified, by loosening the unyielding parts, thereby giving freedom for the contracting casting to move. Castings of intricate form are strengthened on the lighter parts by means of ribs or fins which are cut off later in the dressing shop. In other cases wrought iron rods are embedded in the centre of the lighter parts in order to secure the same end. Large intricate castings, when of light section, are most successfully dealt with by casting in a green sand mould, skin dried and dusted with suitable facing.

The Production of Steel.

Of the various steel-making processes, that known as the crucible is characterised by the absence of strong chemical reactions. High quality in the case of crucible steel, is dependent on initial purity in the materials entering the mixture. Therefore, the process may be described as one of mixing and melting, and skill in its conduct depends on the selection of raw material and adjustment of the charges followed by careful melting practice. The method is famed for high quality, but so far as castings are concerned is only used to a limited extent and then chiefly for special qualities. It is worth noting that in America crucible castings represent an expanding industry.

Bessemer Steels.—The majority of castings produced from Bessemer metal represent modifications of the original process, and the converters employed are generally of the surface or side-blown type. Whatever the type of converter employed, the underlying principle is that of purification by the oxidation of certain impurities. The initial product is molten pig-iron from an iron-melting cupola. This metal is blown in order to oxidise carbon, silicon, and manganese; thus if sulphur and phosphorus are initially low a comparatively pure product ensues. The changes in the conversion of molten cast iron into steel are shown in the following table:—

TABLE II.

—	Cupola metal.	After 5 mins. blowing.	After 12 mins. blowing.	After 14 mins. blowing.	After 18 mins. blowing.	End of blow.	Finished metal.
Graphite	3.180	2.920	—	—	—	—	—
Combined carbon ...	0.350	0.340	2.900	2.300	0.860	0.100	0.240
Silicon	2.310	1.620	0.466	0.382	0.084	0.074	0.326
Sulphur	0.037	0.037	0.035	0.036	0.038	0.038	0.037
Phosphorus	0.054	0.053	0.054	0.054	0.051	0.050	0.058
Manganese	0.610	0.600	0.101	0.040	0.040	0.042	1.080

Open-hearth Steels.—As with the Bessemer, the open-hearth process is based on the oxidation of the impurities in pig-iron. In this case, the necessary oxygen is added in the form of iron ore to a bath of molten metal. The surface of this metal is covered by a layer of slag which shields the metal and also plays a decisive part in the purification of the underlying metal. In acid open-hearth practice, purification is limited to the removal of carbon, silicon and manganese. Details of an ordinary heat are as follows:—

TABLE III.

—	Carbon.	Silicon.	Manganese.	Sulphur.	Phosphorus
Analysis of charge ...	2.90	1.90	0.60	0.04	0.05
Melted metal—					
3 hours after charging	2.50	1.10	0.25	0.04	0.05
1 hour after melting ..	1.87	0.30	None	0.04	0.05
2 hours " " ...	1.48	0.10	None	0.04	0.06
3 " " " ...	0.81	0.05	None	0.05	0.06
4 " " " ...	0.56	0.04	None	0.05	0.06
5 " " " ...	0.39	0.03	None	0.05	0.06
6 " " " ...	0.13	0.01	None	0.06	0.06
Finished steel	0.20	0.02	0.56	0.06	0.06

The foregoing figures give a good illustration of the stages of purification. Sulphur and phosphorus are not removed, and as a rule come out slightly higher than in the initial charge. In the basic open-hearth process sulphur and phosphorus are removed, hence phosphoric irons are admissible.

Electro-thermic Process.—Electric furnaces are attracting considerable attention, and deservedly so. Practically speaking, electro-thermic methods represent basic practice, and very successful results have been obtained in the production of low sulphur and low phosphorus steels from material impure in these respects. In several instances electric furnaces have proved successful in foundry practice, but they have not yet entered into serious competition with established processes.

Comparison of Processes.

The crucible process gives high-grade castings, has a limited capacity and high cost of production. Heavy castings are almost impossible, and further it is difficult to produce dead mild steel by this process. The narrow range in the fluidity of steel has been referred to; this range lessens as the content of carbon falls, and it is difficult to attain the necessary heat in crucible practice to melt a steel of lower carbon content than 0.5 per cent. The crucible process serves a most useful purpose in the direction of special qualities when required in small quantities. Its real limitations are cost and lack of fluidity in dead mild steels.

The ideal process for heavy castings lies with the open-hearth plant, which may be operated either by the acid or basic method, as desired. It is true that basic castings have not yet developed to a great extent, but the future is promising. The plant is costly and necessitates continuous operation if successful working is desired. Furnaces vary in capacity from two tons upwards, and any type of steel, from the softest to the hardest, can be produced. Under current practice the furnace when tapped must be completely emptied. With bulky castings this feature is an advantage, but with light work it necessitates large floor area over which the metal must be distributed. The time occupied by this distribution is apt to lead to chilling, and a consequent danger of mis-run castings towards the end of the casting operation.

The surface-blown converter eliminates the last feature in that the steel is obtained in comparatively small quantities at regular intervals. The steel at the end of the blow is exceedingly hot and fluid: these features supplemented by small weight allow of a rapid distribution over the casting floors, and therefore minimise the danger of mis-run castings in the case of light section. The process is fairly elastic, may be readily started or stopped without serious outlay, and will produce steels of any desired composition. Its special field lies with light and medium weight castings, and good results are being obtained in this direction.

Electro-thermic processes have hardly entered the commercial stage, but so far as foundry practice is

concerned the advantages lie in the high temperature giving fluidity and therefore special applicability to light work. In this direction these processes will have to compete with surface-blown converters.

Sound Steel Castings.

Soundness is admittedly one of the most desirable features in a steel casting, but in addition to solidity the casting must yield certain mechanical properties, therefore the term "sound" may in this section be regarded from a wider point of view than the absence of blowholes.

The shrinkage of steel has been referred to, and the obvious remedy lies in feeding this shrinkage with the requisite supplies of molten steel. Defects due to this cause are usually self-evident, and the casting itself should suggest the remedy. A clear distinction should be drawn between defects due to shrinkage, and those due to unsoundness. In the former case the evidence is shown in pipe, drawn holes, etc., and in the latter case by the presence of blowholes or sponginess.

Contraction has also been referred to, but is does not follow that castings will always show the legitimate $\frac{1}{16}$ in. per foot. In some cases a casting may come out to the pattern size showing no contraction. This may be due to two causes :—(1) the presence of excessive blowholes, or (2) the design may be such as to retard movement when cooling, thereby developing stresses within the casting.

A blown casting does not as a rule feed well, and the steel instead of settling quietly in the mould tends to rise and froth through the feeding heads. Such metal is generally known as wild or fiery. A steel which settles quietly, feeds at a normal rate, and gives the usual contraction, is described as thoroughly dead melted or killed.

In the brief review of steel-making processes it will be noted that the crucible method involves the least chemical change. So far as ordinary steel-making is concerned, chemical change means the oxidation of impurities in pig-iron, and therefore strongly oxidising conditions must prevail. In the crucible furnace oxidising conditions are at a minimum, and, in fact, the atmosphere is often reducing. In the absence of other features this tends to the production of steel free from dissolved oxide and blowholes. An over-oxidised steel does not necessarily imply a steel containing blowholes, but the fact remains that the two are often associated, and the removal of excess oxygen will also tend to freedom from blowholes. Given a high temperature coke-melting furnace, pure iron can be melted, and by the aid of a trace of aluminium only, be poured into sand moulds. The castings are sound, and, after annealing, tough and ductile. The first result in Table I represents a casting produced under these conditions.

In the Bessemer and open-hearth processes the steel is not shielded as in the crucible. When opportunity affords molten steel readily occludes gases, hence under strongly oxidising conditions it follows that oxygen will enter the steel. The affinity of iron and oxygen is such that the oxide formed remains stable at low temperatures. In the absence of any deoxidising additions the oxide formed at high temperatures remains dissolved in the steel at low temperatures. In a casting the effect would be low elongation and an absence of ductility. The steel would be generally described as dry, and would also most probably be riddled with blowholes. The surface of these blowholes is usually free from oxidation tints, and further the actual gas when examined is not found to contain free oxygen. As a rule the gases chiefly present are hydrogen and nitrogen.

The actual volume of gases absorbed by molten steel depends to some extent on the temperature and composition of the bath. Whilst the steel is fluid the gases are retained, but after casting and with falling temperature they are evolved to some extent. Gases set free by falling temperature bubble through the fluid mass, but are more or less trapped when the fluid becomes a pasty solid. As the temperature continues to fall, less movement is offered, and the gases unable to pass through the metal form bubbles at or near the point of evolution; when the casting sets or becomes rigid the formation of blowholes becomes impossible. Obviously, liquid compression should have a beneficial effect in retarding the evolution of gases, but advantage cannot be taken of methods of compression so far as ordinary castings are concerned. The usual method of prevention is by addition to the steel, and the more familiar additions are metallic aluminium, ferro-manganese and ferro-silicon. In shop parlance these elements are described as cleansing agents, and they may be supplemented by sodium, vanadium, titanium, and others.

Judging by results the joint or individual presence of aluminium, silicon, or manganese, tends to remove oxygen existing as oxide, and to increase the solvent power of the steel for gases other than oxygen. In the presence of these elements the gases therefore remain dissolved in the steel, and no evolution occurring during solidification no blowholes are formed. The activity of these elements has been specially investigated by Brinell, and he expresses the effect of aluminium as equal to 90 times that of manganese, and 17.3 times that of silicon. This relation determined from a study of ingots is found to hold in the case of castings, but experience favours the greater use of manganese and silicon rather than aluminium.

The last element has a tendency to increase liquid shrinkage, giving more pipe and leading to feeding troubles. Suitable additions applicable all round cannot be stated, for so much depends on the conduct of the heat. Experience is the best guide, but the object aimed for should be a well-killed steel, and given this there will be no trouble due to blowholes, if the steel is poured into suitable moulds. It may be well to note here, that an occasional blowhole, provided it does not appear on joints or working faces, is not necessarily a disadvantage.

Annealing.

It is sometimes stated that good mild-steel castings can be produced without annealing, but such statements are only true in a limited sense, for much depends on the contour of the casting and also on the particular purpose to which it will be put. The primary object of annealing lies in the elimination of internal stresses, hence the importance of considering the contour of the casting and what it has undergone in contracting from a high temperature. This object is achieved by heating to, and maintaining at, a temperature of about 950 degrees C. for three days, followed by slow cooling. A casting demands very different annealing from that accorded to a forged steel, and the foregoing time and temperature are given solely in view of relieving internal stresses. The second object of annealing lies in breaking up the coarse cast structure, and thereby dovetailing the crystals one into another.

The feature is best shown by metallographic examination before and after annealing. The sharp boundaries in the first case are broken down in the second one, and the inter-crystalline junctions are

strengthened by the interlocking of the ferrite and pearlite areas. Another feature of moment lies in the fact that any dangerous sulphide of iron films present in the casting become balled up by the long annealing, and in this form are comparatively harmless.

Variables in Steel Foundry Practice.

From the foregoing it is obvious that many variables may arise in the operations followed which have a powerful effect on the final result. Generally speaking, in standard practice the variable factor offering least control lies in the temperature of the metal as poured. Casting temperature is generally

TABLE IV.*

No.	Analysis. Carbon.	Silicon.	Manganese.	Sulphur.	Phosphorus.	Max. Stress Tons per sq. in.	Elongation per cent. on 2 ins.	Reduction of area per cent.
80 A	0.29	0.07	0.16	0.07	0.06	24 2	9.5	18 0
81 A	,,	,,	,,	,,	,,	27.2	24.0	32.3
82 A	,,	,,	,,	,,	,,	27.0	12.5	17.5
83 A	,,	,,	,,	,,	,,	25.5	8.0	12.0

* Author. "Journal of the Iron and Steel Institute," 1904. No. 1.

viewed from the point of soundness and too high or too low a heat will lead to the presence of blowholes, cold shuts, etc. This feature is the least evil, and the author's researches led to the conclusion that the effect of varying casting temperature should be considered from the point of mechanical properties. If a series of castings are poured from one ladle commencing with an exceptionally high temperature and finishing with the lowest at which the metal will flow, the mechanical properties of the series will be found to rise until a fair casting heat is reached, and then fall with each successive fall in temperature. These varying properties obtained from steels poured from one ladle within a few minutes of each other, are not restored to one level by subsequent treatment. The following tests represent steels poured from one ladle at intervals of a few minutes; they are of identical analysis, and were annealed together.

The elongations and reductions of area shown in Table IV. are worth examination. Generally speaking, steel castings are low in carbon, and therefore possess a high melting point. As a result the danger will be to err on the low rather than on the high side. This has been examined by taking crucible steel which had not been overheated, and pouring sets of castings at the fair and a low heat. The results are given in Table V.

TABLE V.

No.	Analyses. Carbon.	Silicon.	Manganese.	Sulphur.	Phosphorus.	Casting Temp.	Condition.	Tensile Tests. Max. Stress Tons per sq. in.	Elongation per cent. on 2 ins.	Alternations of Test. Reversals to complete fracture.
97	0.36	0 22	0.89	0.02	0.02	Fair	As cast	35.8	12.5	68
98	,,	,,	,,	,,	,,	Low	,,	34.2	11.5	48
97 A	,,	,,	,,	,,	,,	Fair	Annealed	27.0	17.5	122
98 A	,,	,,	,,	,,	,,	Low	,,	28.2	18.5	62
99	0.37	0.18	0.87	0.03	0.02	Fair	Forged	40.9	27 5	546
100	,,	,,	,,	,,	,,	Low	,,	40.1	28.0	172

Here it will be noted that the tensile results show no variation. Differences in bending led to alternating tests being made, with the results shown. The low heat even after annealing is not brought up to the level of the fair heat in its cast condition. A similar steel cast under the same conditions into two ingots and forged into 1-in. round bars gives the results shown. These results are included by way of showing the survival of the influence of varying temperatures when the steels have been submitted to identical forging treatment. Here again tensile tests do not discriminate between ductile and brittle material.

Incidentally the forged results show the beneficial influence of work on steel and offer a good illustration of the difference between forged and cast steels of like analysis.

Dust Removal in Foundries.

The use of the centrifugal fan is coming more and more into favour for removing the dust which is associated with the operations of foundry machine shop and similar works. The removal of the dust from grindstones and emery wheels particularly is essential to the satisfactory operation of a machine or dressing shop for castings, and numerous designs of apparatus for this purpose have been placed on the market.

The centrifugal fan, being capable of setting up a considerable water-gauge, is frequently applied to an extensive system of duct-work, which may comprise underground flues or overhead sheet-metal piping, or a combination of both. The design of these ducts must be carried out most carefully, as a badly-arranged exhaust system may involve an unnecessary high power consumption, with a consequent loss of efficiency. The ducts must be of ample dimensions so as to reduce the water-gauge, and thereby the running cost—which is by far the most important factor to consider, even if the first cost comes out rather high. Further, sudden changes of section in the duct-work may mean power-absorbing eddies; the ducts must be allowed to taper gradually, and be provided with easy bends. If an exhaust system be badly designed, it is useless to attempt to improve it by increasing the speed of the fan beyond a reasonable limit, as this not only increases the power consumption unnecessarily, but may also prove objectionable to the workers by producing air currents of unpleasantly high velocities. A dust removal plant must have correctly propor-

tioned ducts, which will give an even flow of air at all the inlets; otherwise even the best fan cannot be expected to—nor will it—give satisfaction.

If the ducts can be laid beneath the floor level, it is, of course, a decided advantage to do so, because they leave the machines more accessible and the room less encumbered. In the majority of cases, however—particularly where the dust removal plant is applied to an existing works—it is impossible to employ underground duct-work, and consequently the overhead system must be resorted to.

FIG. 1.—DUST REMOVAL FROM EMERY WHEELS.

FIG. 2.—DUST REMOVAL FROM EMERY WHEELS.

While the general arrangement of the plant presents no particular difficulties beyond those caused by local conditions, such as the position of the machines, or the introduction of the duct-work without causing obstruction, the devising of the hoods to cover the wheels is not such an easy matter. On the one hand it is desirable that they should enclose the wheel as much as possible, while on the other they must not interfere with the work or obstruct the light. The hood must also be capable of being easily removed, so that the stone may be changed without trouble, to suit the work in hand.

As regards the design of the hood itself, it should be as nearly as possible the width of the stone, while its upper edge should project beyond the tangent to the stone at the farthest point at which the grinding may be done. This ensures the heavy particles of dust being caught as they are flung off the rotating wheel. By providing an opening as close as possible to the wheel itself, and at the base of the hood, the finer dust will be collected and removed by the influence of the exhaust draught.

The illustration herewith (Fig. 1), shows a typical installation. An underground duct runs the length of room, communicating by means of branches with each of the hoods. In the background a "Sirocco" exhaust fan can be seen, with the bend in front connecting the suction opening with the udergrounde duct. The fan is discharging the dust through the window into a collector outside.

Fig. 2 represents a 25-in. diameter "Sirocco" fan removing the dust from 14 emery wheels. The exhaust duct in this case is above the floor level, and runs to the right and left of the fan behind the grinders. The fan discharges the dust into the water tank, filled to a depth of 6 to 8 in.; the dust-laden air strikes the water on which the dust is deposited, while the air rebounds and returns freed from impurities to the workshop, through the space between the discharge pipe and the water tank casing. A cyclone dust collector is more usually employed in preference to water tank.

The makers of the "Sirocco" fans employed in the installations illustrated are Messrs. Davidson & Company, Limited, Sirocco Engineering Works, Belfast.

Snap Flasks.

By J. E, Moorhouse,

Snap flasks for producing moulds are now used in most foundries for repetition work. The good quality of the castings turned out with such apparatus is somewhat surprising considering the crudely constructed wooden snaps used in many foundries. No doubt this is partly due to the fact that the cope half being rammed direct upon the drag and replaced, will find its correct position due to the contour of the joint for weighting the moulds, many use pigs of iron for the purpose; the result is that the weight, not being evenly distributed over the surface of the mould, allows the mould to swell, and gives a distorted casting. It is advisable to use jackets (iron bands rammed in the snap are a still further improvement over jackets, though more expensive) in place of packing the moulds with sand, there being a danger of crushing the moulds when

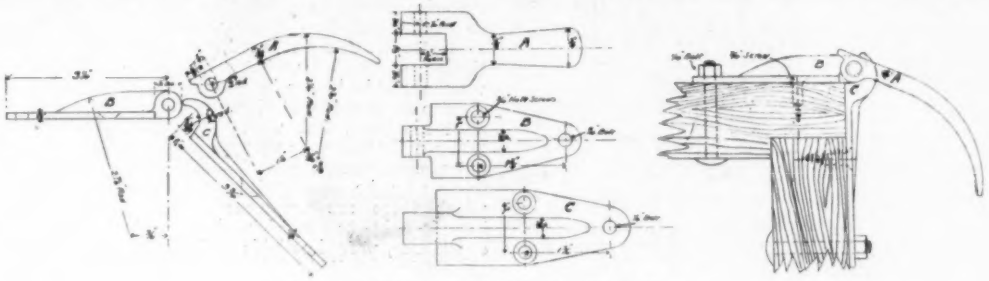


FIG. 1.—DETAILS OF CATCH FOR SNAP FLASK.

on the parting line. With a snap working a match plate, however, the correct location of the two halves in relation to each other and the patterns on the plate depends entirely on the pins, so that if castings free from overshot joints are to be obtained from snap moulding with match plates, it is evident that they must be durable and substantially constructed. Not only must the pins allow a smooth fit and no play in the two halves of the snap, but they also must fit the plates with the same precision. There are, however, the thickness of sand intervening between the pattern and the snap is only small. Taper snaps (½ to the foot) are best for general use, although they are not used to the same extent as the straight ones, possibly on account of the extra expense in making them and the jackets to suit. The advantage gained, however, more than justifies the extra expense, as the jackets more effectually bind the mould together. In addition to this, their removal from off the mould is accomplished with much less exertion than with straight ones.

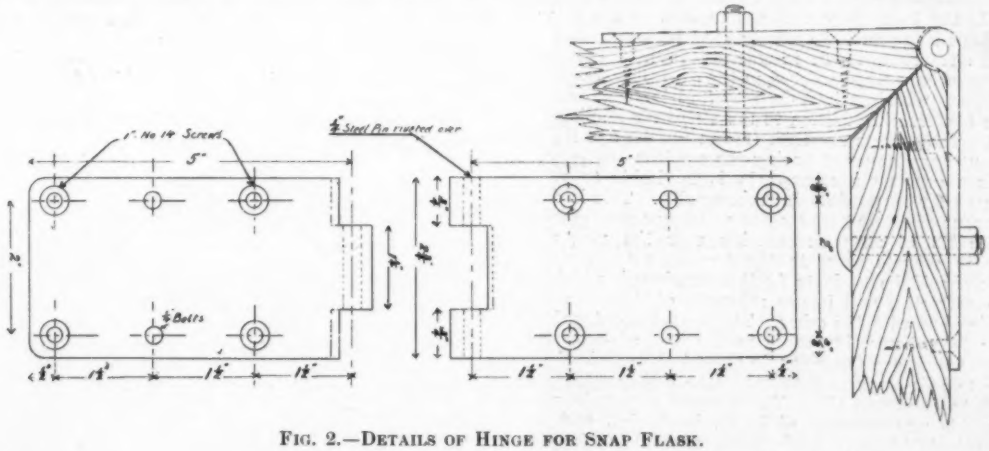


FIG. 2.—DETAILS OF HINGE FOR SNAP FLASK.

various reasons to account for over shot castings, apart from the construction of the snap or the use of it. In many foundries the moulds are placed direct upon the foundry floor apart from bottom boards; this will often cause the mould to crack perceptibly, when released from the snap, due to the unevenness of it. Again, in place of the regular type of flat snap weights

When making taper snaps and jackets to suit, it is best to make then to fit a standard taper form. This form is first made to suit the smallest size of snap and around it the flasks and jackets are built. If larger sizes are required, additional boards are fixed on the form, and upon these the larger size of flasks are built Assuming the smallest size in the set to be 12 in by

10 in., a 1 in. board placed on each of the sides of the form would make a 14 in. by 12 in. and so on. Fitting the snaps and jackets to the same form will ensure the jackets being a good fit when placed over the mould.

In Fig. 3 are shown sketches of the form of sides usually adopted in wood snaps for holding the sand, Nos. 2 and 3 being most effective for the purpose, and scalloped as shown. These are, however, objectionable when jackets are used, because the projecting sand has to be sheared off the mould by the jacket when being placed, and should there be a bit of iron or a nail projecting, the mould may be broken off by the placing of the jacket. When jackets are used it is advisable to make the sides of the snap as shown in

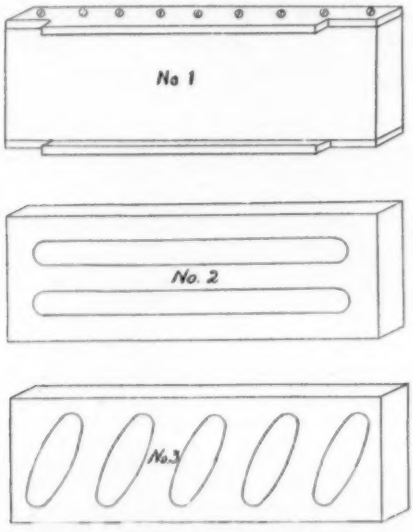


FIG. 3.—SIDES FOR SNAP FLASKS.

No. 1, the iron strips that are secured to the face of the joint being made to stand on the inside about ¼ in. If this is found to be insufficient to hold the sand a piece of hard wood secured in the centre of the depth of the snap half an inch deep by 3-16 in. wide will be quite effective in addition to the strips for holding the sand. The jackets are then free to enclose the mould without any danger of paring the sand.

When constructing snaps it is advisable to make them as far as possible interchangeable. This is done by means of a test-board, upon which are set the standard sizes of snaps, measuring over the pins that work in sockets fixed to the board. All additional snaps should be made to fit this test-board, which, if done correctly, will insure all parts of the same size working one with the other. The advantage of making snaps interchangeable saves in the cost of extension strips, which are necessary to extend the depth of the snap to suit various patterns. One instance may be cited to illustrate this. Three snaps are made with an inside measurement of 14 in. by 12 in., and are respectively 2½ in. drag by 3 in. cope, 3 in. drag by 4 in. cope, 4 in. drag by 5 in. cope. From these the following sizes may be had:—2½ in. drag by 3 in., 4 in. or 5 in. copes, 3 in. drag by 3 in., 4 in., or 5 in. copes, 4 in. drag by 3 in., 4 in., or 5 in. copes. This system can be further extended and made to make three parted snaps by constructing a right and left hand to interchange with each other. To do this the cope part of each must have a double set of ears, set 1½ in. off the centre line of the snap. Sets of three parted snaps can then be made to give a total depth ranging from 8½ in. to 12 in. This is very useful for the jobbing foundry, when the orders from any particular casting are not sufficient to have a special snap built to suit.

Not only is it of advantage to have the snaps themselves to interchange, but for plate work it is most necessary, as one plate will be required to work various patterns of different shapes and depths requiring a change of snap to suit. Apart from a system of standardising, a great amount of expense would be entailed in having to change the pins or ears on the plates to suit the odd size of snaps used. For convenience it is advisable to number all and record them with full particulars of size, etc. This will save a loss of time in hunting for a particular size. The number and size should be painted on each half of the snap so that it can be distinctly seen. If the plates and machines are also numbered, the whereabouts of a particular snap and for what job it is being worked can very readily be known by reference to a record.

Snap flasks made of aluminium are still a luxury to most moulders, but where they are used they give entire satisfaction, as they not only hold true to shape but are extremely light. The fittings for wooden snap flasks may be made of brass or malleable iron, of which there are numerous designs, but the writer intends only to describe those which have, in his experience, proved reliable and serviceable. The catch shown in detail in Fig. 1 is worked on the cam principle. It is easily operated and very effective in keeping the snap close while being rammed. Referring to the sketch, the piece C fits over the nose piece on B, and is held in position by the handle A, sliding over the cam shaped hump on C. This action will take up any wear that may arise. These parts are secured to the woodwork of the snap by the bolts and screws as shown. If white pine be used for the snap, it should be about 1½ in. thick for snaps up to 18 in. square, and 2 in. thick above that size. The fast corners of the snap are tongued and glued to each other. The timber can also be improved by previously boiling in paraffin for several hours. Birch, or American cherry, is also very serviceable, and snaps up to 16 in. square made of this material may be 1 in. thick.

The hinge in detail is shown at Fig. 2, the jaws preferably being milled out to a working fit, as any play in these snugs will leave a rickety snap, and throw away what otherwise may have been a well-

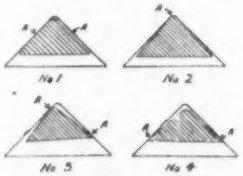


FIG. 4.—SHOWING SHAPE OF PINS AND EARS.

constructed snap. The hinge is secured to the snap by means of two bolts and four screws in each plate as shown. The type of pins and ears usually adopted is shown in section in Fig. 4. No. 1 shows how they should fit. Nos. 2, 3, and 4 how they are usually found to fit in practice. If a snap be worked off a plate the pins serve a two-fold purpose; they not only accurately locate the snap in relation to the pattern on it, but also serve as a guide in the stripping of the plate from the mould. For this reason they should be sufficiently long to cover the lift of the patterns

so that no freedom of the snap is felt until clear of them. The vee-section pin is one of the best, providing the pin be machined to the correct angle and set on the snap to bear evenly in the socket, as shown in No. 1 (Fig. 4). When snaps are interchangeable it is a difficult matter to do this without getting the condition of things shown in Nos. 2, 3, 4,

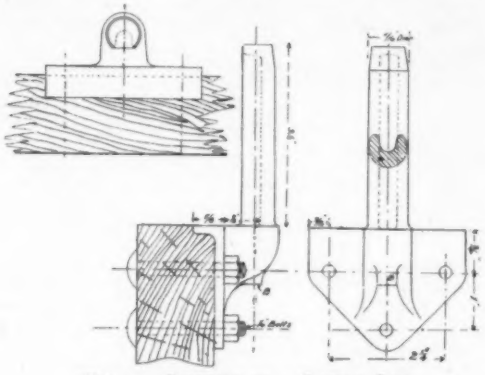


FIG. 5.—DETAILS OF A ROUND PIN.

which is objectionable, because the points marked A being the only bearing surface, very quickly wear away, and leave a slack fit. As mentioned previously however, for odd side and spray work this small discrepancy in the fit may not seriously affect the castings, as the unevenness of the mould at the joint will lead the two halves into their correct position. At Fig. 5 the details are given of a round pin, turned throughout its length, which works into a vee socket

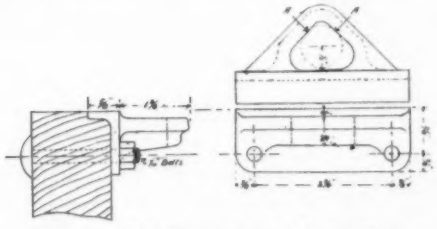


FIG. 6.—VEE SOCKET FOR ROUND PIN.

shown in Fig. 6. This is a good arrangement, and allows an easy adjustment of the snap on the plate without changing the points of contact between the pin and the socket. A lip, B, is cast on the pin to carry the centre of the lathe for convenience in turning. These are secured to the snap in the manner shown, and should be made so that an even pressure is required to place the two half snaps together for the full length of the pin. If the match plates be of wood or composition, a similar set of pins and ears can be attached to them, to work with those on the snap. With metal plates using round pins, two pieces of metal are bolted on each half, but on opposite sides of the snap, ¼-in. thick and the same width as the thickness of the timber, also long enough to allow the pins to stand off the centres for 1½ in. and for the holes to be drilled to suit a similar set of pins on the plate. These holes are drilled from a jig to ensure an accurate fit. On both the snap and the

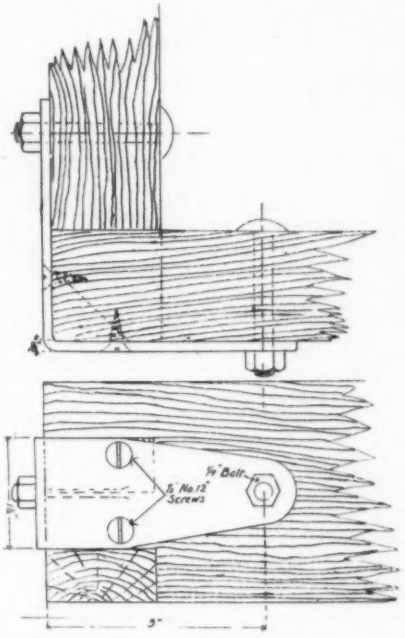


FIG. 7.—DETAILS OF CORNER PLATES.

plate one of the two holes is elongated slightly in a line with the centre line of the pins. The reason for this is to allow for the trifling variation of the snap which may occur, due to the varying conditions under which it is worked. This difference being so small is not observed in the castings, but would be quite sufficient to jam the pins in their sockets if this precaution was not taken. It is advisable to stiffen the corners of the snap by angle plates, and Fig. 7 shows the details of how these can be made and secured to the timber of the flask.

NICKEL-BRONZE GEARS.—Nickel bronze is now being used with success for bronze gears. It consists of a good copper and tin mixture with a small quantity of nickel. A little phosphorus is added in the form of phosphor-tin to impart good casting qualities, but when so used the amount must be small. The following mixture will be found satisfactory for the purpose: Copper, 86 lbs.; tin, 10 lbs.; nickel, 3 lbs.; and 5 per cent. phosphor-tin, 1 lb. The nickel is melted with part of the copper, say 20 lbs., and then the remainder is added. The tin is next added, and lastly the phosphor-tin. The whole is well stirred. This mixture will give a hard bronze gear of great wearing qualities and tough enough to stand any shocks which may be made by using less nickel.

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Open-Hearth Furnaces at the New York State Steel Company's Works.

The extensions to the open-hearth steel plant of the New York State Steel Company, at Buffalo, U.S.A., now in progress, comprise an additional blast furnace, three more Talbot open-hearth furnaces, making five in all, and various finishing mills. A feature of prominent interest in the plant is the directness with which the production of open-hearth steel direct from the ore has been worked out. Incidentally a number of new ideas are embodied in the construction. These include the blast furnace top filling arrangement, the location of the mixer so that metal runs directly into it from the blast furnace, several of the features of the open-hearth charging arrangements, and the combination ingot stripping and charging cranes in the pit furnace building. From particulars published in the "Iron Age" we have abstracted the following description of the Talbot open-hearth furnaces :—

The Talbot Open-Hearth Furnaces.

A 40-ton ladle crane commanding the charging floor of the open-hearth building and cast house carries the metal from the mixer to the Talbot furnaces. A refractory lined cast-iron runway is inserted in the door of the furnace for the pouring of hot metal from the ladle. The open-hearth plant consists of two 200-ton Talbot tilting furnaces, each being 53 ft. long and 16 ft. wide in the tilting section. As shown in Fig. 1, each furnace is supported upon four large wheels which run upon a circular track, thereby tilting the furnace without disturbing the centre of its ports. The tilting of the furnace is accomplished by means of motors supported directly upon it. The rack and all gearing for tilting the furnace are steel castings. No hydraulic pressure is employed in connection with these furnaces, everything being electrically operated, including the reversing of the valves and the opening of the doors. The door hoisting mechanism is shown in Fig. 2. Each door has an independent hoist operated by a motor suspended below the gear frame, driving a worm by a pinion and gear. The crank for lifting the doors is keyed to the extension of the worm shaft.

Gas producers were installed and for a time producer gas was used. However, oil is now the fuel employed. It is stored in tanks adjoining the open-hearth building, and is introduced through the usual piping to the ports of the furnaces. The ore, mill scale and burnt limestone required in the open-hearth charge are brought up to the open-hearth charging floor by an electric incline hoist at right angles to the line of the furnace. The limestone is burned in kilns located close to the open-hearth building. Ore is loaded into the boxes from bins in that part of the ore trestle nearest the open-hearth furnaces, these bins being filled by larry car in the same way as those carrying ore for the blast furnaces.

A Rotary Charging Machine.

The cars of filled charging boxes, after being pulled up the incline, stand on a track at the end of the open-hearth building, while the boxes are picked off by the charging machine. This machine is of a special type, with rotating trolley, so that the

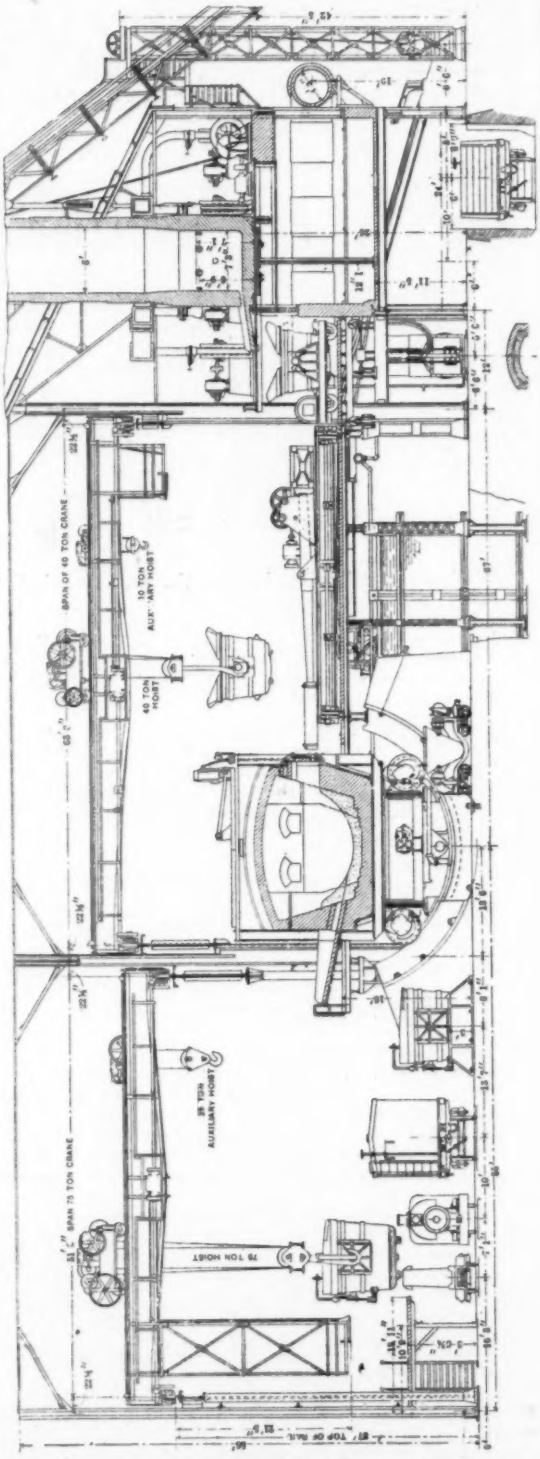


FIG. 1,—SECTION THROUGH OPEN-HEARTH BUILDING AND CUPOLAS,

charging boxes can be packed up and swung around 90 degrees to the furnace doors. This charger is constructed of steel forgings and steel castings, practically no iron being used. The span from centre to centre of rails is 34 ft. 6 in., and the wheel base is 16 ft. 0½ in. The total height over all is 8 ft. 6 in. There are five electric motors. The

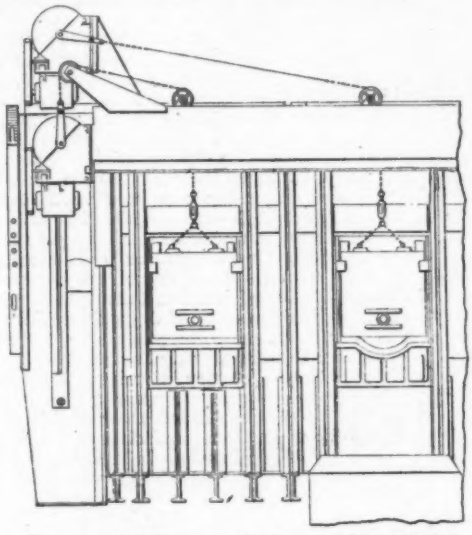


FIG. 2.—METHOD OF RAISING OPEN-HEARTH FURNACE DOORS; NEW YORK STATE STEEL COMPANY'S PLANT.

main traverse motor is 50 h.p.; the lifting trolley traverse and charging bar rotating motors each 30 h.p., and the trolley revolving motor 11 h.p. The charging bar can be rotated about 12 revolutions per minute, and the trolley about 3 revolutions per minute. The armature of the lifting motor is provided with an automatic electric brake operated by solenoids in such a manner that should the current fail from any cause the brake will immediately act and prevent the load from falling.

To the top section of the trolley frame, which revolves on ball bearings, is attached the charging bar. This is made in two pieces, allowing the front part to be renewed in case of accidents. The front end of the charging bar is made to fit into a recess on the back of the charging boxes. Its head is provided with two double inclined faces. These are exactly duplicate, with their meeting edge on line with the centre of the charging bar. If, after the lower end of the charging bar has entered the pocket, the box should not be in the exact position to permit of the free seating of the head therein, the inclined faces on the bar head and on the pocket coming together will cause the box to shift its position to receive the head. The flanged end of the charging bar having double inclines and the sliding lock being located in plane with the centre of the bar, it can thus be used either side down, and if one side is damaged the other can be used. To lock the boxes to the charging bar the locking rod is pulled back toward the operator, thus putting this rod in tension. As the operator can always see whether the box is secure, it is held that this design of box reduces the number of lost boxes to a minimum.

The practice at the Buffalo plant has been the typical Talbot practice, and the results have been quite uniform; each of the furnaces produces 200 tons in 24 hours, this amount having been exceeded in a number of instances. About 50 tons of metal are tapped out at each cast. The reserve metal being very low in carbon (about 0.04 per cent.), the addition of a fresh pot of metal from the mixer is attended with a violent ebullition, the product of the reaction. These additions vary from 25,000 to 40,000 lbs., depending upon the kind of steel desired. The maintenance of a limy slag of good depth and of a freely oxidising slag (by the charging of iron ore and scale, or both) is the condition of speedy and satisfactory refining. On the pouring side of the furnace the ladles of metal are handled by a 75-ton 4-girder crane.

The Bosshardt Casting Process.

In our issues of January and April, 1909, we published particulars of the "Bosshardt" process for producing malleable iron castings without annealing. This process, it is claimed, solves the problem of providing a cheap but effective substitute for malleable iron and steel—in other words, castings as ductile as wrought iron, yet as tough as the forged steel. About the year 1886 the possibility of obtaining sound and ductile unannealed castings from the melting of Swedish or other wrought iron, by means of a certain small addition, was discovered, patented, and published by Nordenfeldt (of gun fame) and Mr. Oestberg, of Stockholm, Sweden. The castings so obtained were styled "mitis" by the patentees; they, however, failed to put their method on a successful commercial basis, though the method was developed and extensively used for research and instructive purposes in the steel works of what is now the University of Sheffield.

The Bosshardt process appears to have had better success. Although not a British invention, it will be operated in works in this country, wholly under British control, the Vulcan Iron and Steel Company, Limited, having been formed with works at Leeds and a directorate which includes the well-known principals of kindred Yorkshire undertakings, to exploit the Bosshardt Casting Process in the United Kingdom. From a commercial point of view, one of the most important features of the process is that it produces malleable castings without recourse to the long and tedious process of annealing, which occupies from fourteen to twenty-eight days, and, of course, involves working costs as well as the provision of non-productive plant. The castings are ready for use as soon as they leave the mould, and need no hardening. Thus, in cases of emergency, castings may be removed from the sand and put into full use within two or three hours of actual tapping of the metal. The metal being perfectly homogeneous, the castings are so ductile and malleable that they can be drawn out hot or cold, twisted and hammered to the thickness of a piece of paper without affecting the tenacity of the metal. The castings have been repeatedly tested at the Leeds University to stand a tensile strain of 32 tons to the square inch, with an elongation as high as 40 per cent. on two inches, and a reduction in area of from 43 to 51 per cent. In previous processes broken castings made from soft materials could not be repaired, and welding with other materials or to other steel parts was impossible. Tougher steel parts for hard wear had to be forged and cut from solid ingots by costly processes, and the weight was so great a handicap that machinery designers aiming at the combination of strength with lightness had recourse to phosphor-bronze and nickel steel. The Bosshardt process, we understand, abolishes such limitations.

Adding Steel to Cast Iron in the Cupola.

By J. F. P. L.

The practice of adding steel to cast iron in the cupola shows signs of coming more into vogue, the steel being added as scrap or as shavings, turnings, filings, etc., pressed into briquettes. In some cases the steel is first combined with iron in the form of ordinary pig, branded with some patent name (*e.g.*, the German "Concordi" iron). In whatever way steel be mixed with iron in the cupola for ordinary foundry work the writer considers it a mistake. Theoretically there is a case for mixtures of this kind, the theory claiming that the addition of steel should decrease the impurities in the metal, especially carbon and silicon, and hence raise the product as regards mechanical quantities nearer to the level of steel itself. If this theory were effective in the ironfoundry as such, it would appear that the ironfounder had got hold of something almost too good to be true; he might wage war against the steel foundry itself, and get orders for many castings which at present, owing to strength specifications, are beyond his scope. Could these iron-steel compounds do all that is claimed by some enthusiasts, there would hardly be an ironfoundry in which the system was not in general use. It would simply mean revolution. But this revolution has not come yet, and the mere fact that it has not is strong evidence that the claims made in respect of the value of these steel additions have been greatly exaggerated. Herewith are given some reasons why it is, if not impossible at any rate extremely difficult, for an ironfounder melting in cupolas to improve his castings by these steel additions.

In the first place, let it be considered how easy it is to go wrong with mixtures of ordinary pig-iron owing to the mixture consisting of ingredients having different melting points. It is often the case with pig mixtures that they will contain individual irons varying in their melting-point by as much as 200 degrees C., and founders are often troubled by irregular results through this fact. How greatly then is this danger increased when steel is added, which at once vastly increases the maximum variation between the points of fusion of different parts of the mixture.

The registration of different temperatures in a cupola furnace is a very difficult matter, and there are no very reliable dead records of temperatures at which different metals melt in a cupola; but it is conclusively established by comparative tests that the melting point of steel is very much higher than that of any kind of cast iron. Should the ironfounder therefore wish to make absolutely sure that his iron and steel are giving him a practically homogeneous casting, he would have to mix them after melting, a most undesirable thing; or he would have to increase the amount of his fuel and blast pressure so as to bring the whole charge down like water in a very few minutes, which would not be economical and would probably play havoc with his cupola lining. Further, this strong blast might have such a violent reducing effect on the iron portion of his charge as to make his castings as hard as flint.

The first alternative would perhaps be the best, since steel and iron may be fairly well combined by energetic stirring in a ladle in large quantities. But for such castings as a mixture of steel and iron would probably be destined for, the best practice is to pour them quickly and with the hottest possible iron. The stirring and agitation of pure high-grade foundry mixtures is not advantageous. Apart from the disputed action which this has on the metalloids, the metal will be chilled, and as steel loses its heat and fluidity much more quickly than iron, it would greatly assist in turning the metal sluggish. These points suggest the difficulty of properly mixing iron and steel, and the proof that the objections are sound is furnished by many founders who have tried to add steel and have found their castings full of hard spots, and sometimes a regular mottle of steel and grey iron. Kirk (author of "The Cupola Furnace") expresses the opinion that when good metal is tapped the incorporation of different grades of iron has taken place whilst the metal was descending in small drops down through the cupola. If this is so it seems clearly impossible for iron and steel to mix properly in a cupola.

In addition to this difficulty of mixing there are others which are even more pronounced. The writer has assumed that the idea behind steel additions in the cupola is that of purifying and strengthening the metal by considerable reductions in the impurities, especially carbon and silicon, which the percentage of steel theoretically would bring about. Now this purification is very much less than might be expected, and under not infrequently recurring cupola conditions may be nil; the reason being that steel melted in a foundry cupola absorbs carbon furiously, and is similarly greedy for any sulphur or phosphorus that may be present in the fuel. When it is remembered how studiously careful the steel founder has to be even in reverberatory furnaces to prevent steel taking up the smallest trace of any foreign element, it will be realised how hopeless it is for the ironfounder to expect to maintain the pristine qualities of steel when it is placed in a cupola along with sulphurous fuel and sundry fluxes, and immediately in contact with carbonising gases and oxidising flames. The original character of steel is absolutely destroyed by melting it in a cupola, and hence the question is reduced to this: Can steel, being a low-carbon, low-sulphur, low-phosphorus component, materially reduce these elements in a foundry metal, even though it cannot confer very steel-like physical attributes on the castings themselves? To get an answer to this it is best to take actual records of castings made with mixtures of iron and steel. The writer recently analysed portions of metal from a cylinder casting made by a large firm of locomotive engineers who were using a good percentage of steel briquettes in their mixture. At the same time the iron from a cylinder cast from a high-grade cast-iron cylinder mixture was analysed. An examination of the results is of the utmost interest and importance:—

	Iron and steel mixture.	Cast iron alone.
Comb. carbon	1.281	0.381
Graphite	2.827	3.360
Silicon	1.414	0.928
Sulphur	0.100	0.141
Phosphorus	0.665	0.928
Manganese	0.551	0.662
Iron (by difference) ...	93.162	93.600

It is not proposed to discuss various features in these analyses, but merely to point out that in the iron and steel mixture the total impurities are positively higher. The total carbon stands at a disastrously high figure, and the silicon certainly above

the limit generally fixed for high-grade cylinder castings.

Again, there is a firm of engineers who are using additions of 40 per cent. of steel and wrought iron for large gas engine cylinders. The analysis of their castings shows a carbon of 3 per cent. and a silicon of 1 per cent.; neither of these items are at a lower figure than could be arrived at by the careful mixing of selected grey cylinder pig-irons, and the percentage of metallic iron is not higher than in a good all-pig mixture. It therefore appears that additions of steel alone or of steel and wrought iron do not bring about a material reduction of the foreign elements in iron castings.

It has now been demonstrated, first, that it is extremely difficult to mix iron and steel by means of the foundry cupola; and second, that the resultant castings, however well mixed, do not show an analysis noticeably different from all-pig castings. It might now be considered whether the iron and steel mixtures as cast confer any special physical quality on the castings not to be arrived at by an all-pig mixture. The writer has never seen a single demonstration of such a fact; it rather has appeared that one of the chief physical effects of steel when mixed with iron is to soften the finished product. It has been found by experiment with steel mixtures melted in cupolas that small additions of cast iron considerably increased the hardness. The reason of this is somewhat obscure, and may possibly be connected with the carbons in the mixture. It might be pointed out that the amount of carbon contained in the steel used will have an important effect on the result. Mild steel would probably be most helpful in lowering the final carbon content, but, on the other hand, would aggravate the trouble caused by raising the melting point. Hard steel would melt at a lower temperature, but would raise the final carbon; in fact, a combination of high-carbon steel and high-carbon iron would probably yield a very weak and soft metal. Further, complaints are not uncommon to the effect that steel-iron mixtures have given porous castings, or have resulted in bad blow-holes and shrink spots. This is easily understood when the nature of molten steel is considered in comparison with molten iron. Steel has higher and more rapid shrinkage accompanied by a shorter period of fluidity, while it expels much more gas; it is for these reasons that it is notoriously more difficult to cast than iron.

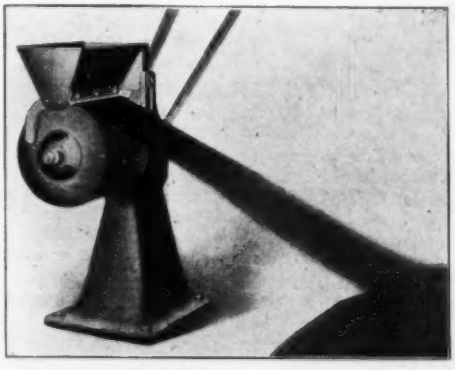
The writer has sought, therefore, to establish four important points:—(1) That it is almost impossible to get a proper mixture of iron and steel in cupola work; (2) that steel entirely loses its characteristic qualities when added to iron in the cupola; (3) that iron is not purified by additions of steel in the cupola; (4) that no manifest advantages in connection with the physical or mechanical qualities of the finished iron-casting accrue from steel additions.

The foregoing opinions are based on practical observation, but it would be somewhat extreme to state that in no case and under no circumstances could an ironfounder improve his castings by adding steel, though that this improvement is possible under normal and generally existing ironfoundry conditions, is open to grave doubt. That steel briquettes or steel offal of any kind may cheapen castings is quite probable, but the question of quality, rather than cheapness, is at the moment under consideration, for in the best foundries where high-grade engineering castings are turned out, quality would never be sacrificed for the sake of saving a few shillings a ton on the foundry mixture.

In conclusion, the writer would urge ironfounders in their own interests to discourage the use of steel and stick to ironfounding. For it must mean in any case that the nearer the mixture approaches steel the more rational it is to suppose that it will be more the province of the steel-founder than of the iron-founder to cast it. The iron-founder should not play into the steel-founder's hands, but should seek to maintain and improve the quality of iron castings as such. In order to turn out stronger, denser and more durable iron castings for all important mechanical purposes, the cheaper and commoner grades of pig should be frankly abandoned, and the best cold-blast and other selected smeltings restored to favour. With such it is easy to raise the quality of important castings above that yielded by ordinary foundry mixtures of to-day by from 30 to 50 per cent. in tensile and transverse strength, and by from three to six-tenths per cent. in specific gravity, and though the cost will be more it should not be difficult to show the engineer that he is getting good value for his money.

The Bilz Sand Mixer and Sifter.

An interesting apparatus for foundry use, intended to take the place of the ordinary sand screens or riddles for mixing and preparing sand, has been placed upon the market by Messrs. Walls, Bray & Company, of New York City, U.S.A. This machine is illustrated herewith, depositing a pile of sifted sand. It consists of a cylindrical wire brush running at about 1,000 revolutions per minute in a hopper, the bottom of which it almost touches, and into which the sand is fed. The rapid revolution of the brush serves to throw out all foreign material, such as stones, wood, nails, etc., and deposits them in a heap beyond the point to which the sand is similarly thrown. The effect of this treatment on the sand is said to be that it is mixed more thoroughly than can be done by hand. The necessity of drying wet French sand before putting it through the sieve is eliminated and the danger arising from broken wires is also avoided. The capacity of the machine is stated at from 50 to 75 barrels per day. The brush is belt-driven, as shown in the illustration.



THE "BILZ" SAND MIXER AND SIFTER.

Plaster False Backs for Hand Moulding.

By Walter J. May.

Where moderate numbers of particular castings have to be made, but where it does not pay to cast and finish a plate, the use of false copes or backs comes in very usefully, as after the initial bedding in of the patterns in making the false back, the work is reduced to a minimum, for even the sprues can be rammed up with the pattern, if preferred.

The flasks, where repetition work is done, should be made in convenient sizes in sets of six, twelve, or any other number for the quantity of work done, while the copes and drags should be freely interchangeable in each set of flasks. In fact, is is always a

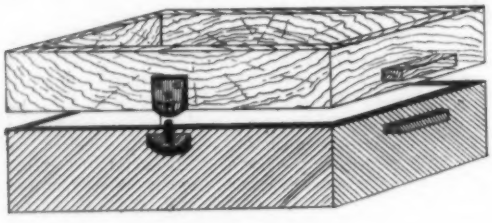


FIG. 1.

matter of economy to have all sets of flasks made interchangeable as regards their component parts, as this allows of a rather considerable saving of time in "pairing up boxes," which occurs where flask parts will only fit the parts to which they strictly belong. In making flasks it takes no longer to have them interchangeable than it does to make each cope fit only its particular drag, the mere use of templets being sufficient to overcome any little difficulty which might otherwise occur.

Having a number of drags of one size makes the use of the plaster backs easy, as one dummy cope will fit the lot, and as a wooden frame only is needed to hold the plaster, the cost is not great, wrought-iron

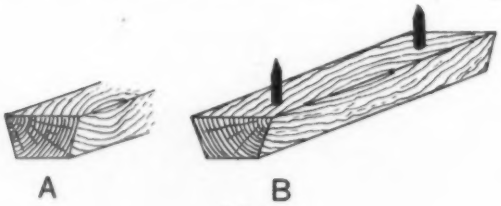


FIG. 2.

brackets being screwed on to take the flask pins. Inside this wooden false cope there should be a fillet nailed on to hold the plaster in place, as it is liable to shrink in drying and drop out when ramming up the mould, and for the same reason the inside of the dummy need not be planed. Such a false or dummy cope is shown in Fig. 1, and further description is not necessary, as any carpenter will at once see what is wanted. The boards used should be from ¾ in. to 1¼ in. thick, in accordance with the size of the flask with which it will be used, but with flasks of large area stays may be needed.

So far as the preparation of the dummy cope is concerned, it may be filled with plaster of Paris or Portland cement, according to size, the latter being the stronger of the two, while to save both weight and material the dummy should not be thicker than is necessary. The point of thickness depends on the height of the patterns, and no fixed thickness of plaster can for this reason be laid down, but it may reasonably be assumed that few dummy copes would exceed 4 in. or 5 in., while in the majority of cases rather less than 4 in. would be required. This is, however, a matter of detail which can only be decided when the patterns are in view, but it may be taken as a general rule that so far as is possible the patterns should, for casting reasons, have as nearly as can be managed the same general projection into the cope,

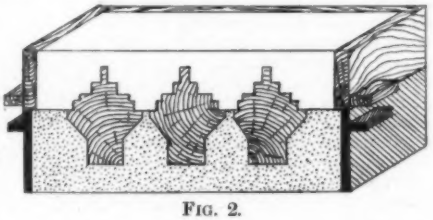


FIG. 2.

and this, of course, would largely govern the thickness of any false back.

In making the plaster back the patterns are bedded in the drag and the joint made as with an ordinary mould, and the surface of the sand well wetted with soapy water. The wooden frame is then put on, a seaming of clay being worked along the outside where the wood and iron joins, and then the plaster or cement is put in and allowed to set, striking off level with the top of the wooden frame. At this stage a section would appear approximately as shown in Fig. 2, the exact form of the patterns being dependent on what is really to be made. When the plaster has set

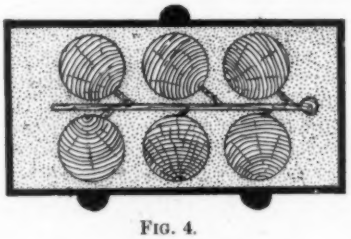


FIG. 4.

fairly hard the false cope is carefully lifted and turned over, any adherent sand removed and the surface rubbed smooth with a trowel, and is then dried. The dry surface of the pattern side should have a couple of coats of shellac varnish to prevent the sand sticking, and when this is dry it is ready for work.

Preferably the runner and sprues should be rammed up with the patterns in the drag, and to secure this strips of wood should be inserted in the drag before making the dummy, these strips being of the proper section, and each having two or more metal dowels to project into the plaster. In Fig. 3, A is a section and B a side view of one form which may be employed. The strips should be varnished the same as the patterns and the wire dowels—wire nails answer very well

for these—should be greased before the plaster is poured into the frame, as like the patterns, these strips must be loose enough to leave the plaster. Roughly, the drag when rammed up will look somewhat as is shown in Fig. 4, when ready for ramming up the cope, and it will be seen that the runner and sprues are in place.

In working, the dummy is placed on a board, the patterns and sprues put into place, and then the drag is put on and rammed up. The whole is then turned over and the dummy taken off so as to leave the patterns in position, the joint made, a dusting with parting sand given, and then the cope is put on and rammed up in the usual manner, other work being the same as where a false cope is not used.

The saving in the time of moulding is considerable. Of course, plate work is far in advance of this class of work, but from the point of view of economy plates are too costly for work where probably only a moderate number of repetitions are needed, and the plaster dummy cope costs, as a rule, very little, and is quite effective as a time saver.

Of course, where rush work is done there is not a wide scope for devices of the kind described, the method of working being very different, the smaller foundries only being able to avail themselves of the more rough and ready methods of time-saving when hand-moulding is wholly relied on. There are, however, many ways of cheapening even hand-work if a little thought is given to the matter.

Strengthening a Loam Core.

By W. F.

Owing to the expense and the small number required of some patterns, it is not advisable to make large core boxes if the core can be struck on a core barrel. Difficulties arise, however, when the core, owing to its position in the mould, has to be removed from the core barrel. If the core should be an irregular shaped one, similar to the one illustrated in Fig. 1, it invariably breaks at the angles,

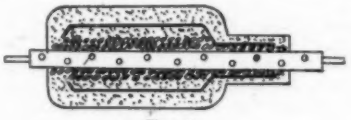


Fig. 1.

owing to shrinkage of the loam when drying. The following method will obviate this trouble.

The core represented in Fig. 1 is for a hydraulic casting, and is struck up in the usual way. A bar of ½ in. iron is bent to the shape of the core, laid in the top, and covered over with loam; the core barrel is then marked, to ensure a similar bar being placed opposite the first one, and the core is struck up the second time. The third coating of loam should bring the thickness to about 2½ in. When dried, the core is removed from the barrel, and the small end that goes in the print is squared so that it will stand upright. Fig. 2 illustrates a slot cut in the top of the

Fig. 2.

core to enable a piece of iron C to be laid in it for fastening the core in the mould.

Fig. 3 shows sectional and plan views of a hydraulic casting with core in position strengthened with the ½ in. bars of iron AA. The staple B has a loop in the top to allow the piece of iron C, Fig. 2, to be threaded through. It is provided with a nut D at the other end to facilitate the fastening of the core to the bottom of the moulding box.

One advantage claimed for a core so strengthened is that it does not require ramming up with sand. The recess left by the removal of the core barrel should be filled up with small coke, and should a core be required for a horizontal position in the mould, it is no trouble to add another strengthening bar if the lift or strain on the core makes it necessary to do so.

BRITISH FOUNDRYMEN'S ASSOCIATION—BIRMINGHAM BRANCH.—A very pleasant interlude to the more serious work of the Birmingham Branch of the British Foundrymen's Association was furnished on Saturday, February 5, when the members and their friends met for a whist drive at the Pitman Hotel, Corporation Street. The company numbered

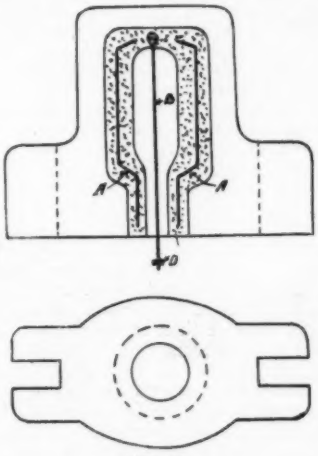


Fig. 3.

seventy-five, and included Mr. F. J. Cook (President of the Parent Association) and Mrs. Cook, Mr. and Mrs. Robert Buchanan, Mr. and Mrs. E. Evans, Mr. C. Heggie (Hon. Secretary and Treasurer) and Mrs. Heggie, Mr. and Mrs. H. Winterton, Mr. and Mrs. J. Grant, Mr. and Mrs. J. Neish, Mr. H. L. Reason and Miss Reason, and Messrs. J. Matthews, F. E. Robinson, J. Hotchkiss, D. Dalrymple, D. Muir, and B. Terry. Mr. Winterton was the Honorary M.C., and the arrangements, as carried out by him and the Hon. Secretary proved highly successful.

Aluminium and the Brass Founder.

By A. Napier.

Since the introduction of aluminium for industrial purposes, as distinct from the special purposes to which the metal in its early days was applied, the variety of uses to which it has been put has been very extensive. In almost every branch of the metal trades some use has been found for it, until now a demand exists for the metal for engineering and mechanical purposes, domestic purposes, and a host of general applications. It is not surprising, then, that the brass-founder, who formerly devoted his attention to copper, white metal and similar alloys, has been called upon at times to handle the lighter metal. This has resulted in a considerable number of brass-founders making the addition of "aluminium-founder" to their title. In America, where there is a very large demand for aluminium castings, the chief founders of the metal confine their attention to it alone, and by specialising in the production of aluminium castings attain a notable degree of efficiency and success. In this country, however, there does not appear to be such a tendency to specialise; the aluminium casting trade remains to a great extent still in the hands of the brass-founders. Since many men who desire occasionally to cast the lightest of our industrial metals have had very little experience with it, and consequently do not always meet with a conspicuous amount of success, the writer proposes in the following notes to offer some particulars concerning the properties and peculiarities of the metal, hoping they will at least elucidate some doubtful points which trouble the average brass-founder when handling aluminium.

General Survey.

Although aluminium was discovered by Woehler as far back as 1828, until quite recent years it was regarded as quite out of the range of general commercial uses, and was certainly never seen in the ordinary iron or brass foundry. The discovery of cheaper means of production, however, and particularly the installation of plants in the vicinity of cheap water power, has resulted in quite a revolution in the application of aluminium, until the variety of uses to which either the pure metal or the metal alloyed with others is put is almost beyond enumeration. The addition of aluminium to the foundryman's list of metals has, however, in many cases rather added to his anxieties and troubles than to his profits. The reason of this is simply ignorance of the way to treat the metal for casting, for it must essentially be handled somewhat differently to brass and white-metal alloys. In the first place, the melting point is very low—1,160 degrees F., or 630 degrees C.—while, also, the metal quickly oxidises when molten and in contact with the air.

As regards the physical properties of aluminium, it may here be stated that the specific gravity when cast is 2.587, and when rolled 2.7. It will thus be seen that it is the lightest of the commercial metals. For comparison the specific gravities of some other metals may be quoted:—Gold, 19.425; lead, 11.445; copper, 8.93; manganese, 8; nickel (cast), 7.8; pure iron, 7.79; cast iron, 7.125; wrought iron, 7.7; tin, 7.3; zinc, 7.19. Magnesium, certainly, has a lower specific gravity than aluminium, viz., 1.75, though magnesium approaches nearer the precious metals in value.

Aluminium when cast has a tensile strength of about 6 or 7 tons per square inch, though this is greatly increased by working. Owing to its high specific heat (0.2185, as compared with copper 0.0952; water at 0 degrees C.=1), it melts, cools and solidifies very slowly.

Pure Aluminium and Alloys.

There are a number of alloys in which a more or less considerable percentage of aluminium is included, but attention will be given only to those where the aluminium is the chief component. The various copper alloys in which are included amounts of aluminium varying from less than 1 per cent. to, say, 10 per cent. should be classed among the brasses or bronzes; the aluminium alloys are those to which copper, zinc, or other metals are added in order to harden the metal or produce some special characteristic.

Taking first pure aluminium castings, it may be said that the application of these is very limited. The metal can now, owing to the high stage that has been reached in its manufacture, be obtained with as much as 99 per cent. aluminium, but as the pure metal is very soft the uses to which it can be put are limited. Since, then, pure aluminium castings are not largely used, it is the alloys of the metal that the founder has generally to deal with. These alloys usually consist of copper, nickel, zinc or manganese, either together or separately and in varying proportions, and aluminium. With these additions much harder and more commercially applicable alloys are produced. The addition of copper may be up to 7 or 8 per cent., this amount being frequently employed, while up to 5 per cent. of manganese can also be added. In order to obtain a suitable hardness with zinc, a much greater amount has to be added, 20 per cent. being a common amount, while in some cases as much as 35 per cent. has been added.

Aluminium in a molten condition readily takes up silicon when in contact with a silicious material. When the amount of silicon contained in the metal is over 2 per cent. the colour is impaired, and the metal becomes less malleable. The effect of silicon is to harden the metal, but it has been stated that up to 5 per cent. may be present without damaging it for use in castings.

Aluminium-Zinc Alloys.

The necessity for some hardening element in aluminium in order to fit it for general industrial uses led to the adoption of both copper and zinc. Tin was tried, but without satisfactory results, and the founder's fancy turned to zinc, partly on account of the cheapness of that metal as compared with copper, and partly on account of the strength of the aluminium-zinc alloys. But there are many troubles associated with the use of zinc in that capacity. While producing a very strong alloy, there is a great tendency for the casting to crack during cooling, owing to the considerable shrinkage. This cracking is the greatest difficulty that the founder has to deal with; for though the casting may be free from pinholes and other defects, and apparently quite sound, cracks will often develop during machining or on the application of a strain, and render the casting useless. Unfortunately, too, these defects often cannot be de-

tected until a certain (perhaps considerable) amount of machining has been done. Aluminium-zinc mixtures are what is known as "short" while hot, and as they shrink more than most of the other aluminium alloys, cracking takes place if the shrinkage is at all restricted.

It is, of course, possible with some castings to allow for freedom of shrinkage, but in a great many cases this is not so, and however well the founder may appreciate this quality of shrinkage he cannot always make provision to meet it. He therefore puts forth futile efforts to do what is for him practically impossible.

It must not be thought that this feature rules out the zinc alloys for all purposes, for where this difficulty can be successfully met, very good, sound, and generally satisfactory castings can be got. But, on the whole, it is not the best metal to use, particularly as the quantity required to give a suitable hardness and stiffness is so great (up to 20 per cent.) as to impair the great feature of aluminium—its lightness. This, of course, is a point in favour of the founder if he is being paid for the castings by weight, for the heavier metal in the alloy materially increases the weight for a given piece, while at the same time being cheaper. But if the user is looking for lightness in his casting he does not appreciate this point. It is not surprising, then, that copper has found greater favour than zinc as an addition to aluminium.

Copper-Aluminium and Nickel-Aluminium Alloys.

A number of alloys now being used for casting motor car parts and for engineering purposes contain up to 6 per cent. of copper, which amount gives a mixture that casts with great uniformity and without the trouble of cracking that is associated with zinc. An additional feature is that the lightness of the original metal is not greatly impaired by this small addition of the heavier metal. It is not proposed to here enter the question of the copper-aluminium alloys, for the results of research work with these have been published that deal very thoroughly with the matter.

Nickel, when added in quantities up to 5 per cent., also gives a series of very useful alloys which are applied to a number of purposes. In most cases the amount of nickel used does not exceed that mentioned, and is often less. Not only is the strength of the aluminium increased by the addition of this metal, but the alloy is much easier to work than the pure metal, and as in the case of copper, the lightness is not materially impaired.

Another very important series of alloys is obtained by the addition of copper and manganese. Recent investigations have shown that the addition of 3 per cent. copper and 1 per cent. manganese gives a very remarkable alloy as regards strength.

The use of these various additions to aluminium for castings has been appreciated for some time, but it is difficult to lay down any rule as to exact quantities, as these vary according to the use to which the alloy has to be put, and the fancy of the founder. Practice with different mixtures is perhaps the best guide in this matter that the average founder can have, though in some cases specific amounts of the different constituents will be demanded by the user.

It may be of interest, in passing, to quote an aluminium alloy patented within the last three years for use in making horse-shoes, viz.:—Aluminium, 120 parts; gun-metal (9 of copper to 1 of tin), 4 parts; and white metal (12 of tin to 1 of copper and 1 of antimony), 1 part. An inspection of these constituents, however, would not suggest any serious advantage over some other alloys of a known strength and hardness.

Melting Aluminium Alloys.

For those who are not accustomed to mixing aluminium alloys the most satisfactory way is to purchase the alloy ready made. It is almost impossible to obtain by mixing the metals in the crucible, as high tensile strength as is obtained with alloys mixed in the bath by the smelter. As a general principle, when mixing the metals in the crucible, the metal with the highest melting point should be run down first and the others added afterwards. But whether melting the metals to mix or melting the alloy, it is extremely important not to overheat them.

Various forms of furnace may be employed, fired by coal, coke, or oil, but the crucible furnace is the most applicable for general work. When using a coke fire it is generally sufficient to heat the bottom of the crucible only, since the melting point of the metal is not high. There is then less likelihood of overheating. Large crucibles are to be preferred to small ones, and some of the patent tilting crucible furnaces employed for brass melting are particularly suitable for aluminium.

When overheating of the metal does occur, scrap pieces, such as gates, etc., may be added to cool it, but it is best to avoid overheating altogether, as in that condition the metal is very liable to oxidise and to absorb carbon and gases, which result in pin-holes and weak castings. The getting of the correct heat is a delicate matter, for the metal will often absorb heat from the crucible after it has been taken from the fire, and the temperature become raised. To cool to the proper point by the addition of gate scrap is then advisable.

As regards the melting of the metal, it is interesting to note the practice of a prominent American aluminium foundry. The metal is melted in clean graphite crucibles in the regular pit-type crucible furnace, the fire being only underneath, as this is found to give sufficient heat without surrounding the crucible with fuel. No flux or covering is used in the crucible, nor is the latter taken from the fire. A long-handled ladle is employed to ladle the molten metal from the crucible into a bull ladle which is not lined, but is first heated to prevent chilling the metal. When the desired quantity of metal is ladled out a small quantity of salt is thrown on to the metal to flux it, after which it is skimmed and poured.

This, of course, does not necessarily represent the general practice in aluminium foundries, for individual founders employ different methods to the same end. But however the metal is melted, and whether poured direct from the crucible or not, care should be taken not to overheat the metal, a low red heat being the most to which it should be subjected.

One great source of trouble in pouring aluminium is the dross that forms so readily on the surface. Owing to the fact that the difference between the specific gravity of the oxide and the metal itself is very little, the two form in a thick, pasty mass, and it is impossible to skim off the dross without wasting a considerable amount of good metal. The dross, also, is very difficult to properly remove. A number of fluxes have at different times been employed to overcome this trouble, but with most of them there was some serious fault. If charcoal, for instance, is used, it is very difficult to skim it off and it is apt to get into the mould. Salt is to a certain extent efficacious, but does not readily melt, though it is used in a good many foundries. Chloride of zinc is claimed by some to give excellent results, particularly with alloys of aluminium and zinc, and is added, after the metal has been removed from the fire and cooled to the desired temperature, by being thrown on the surface of the metal in the crucible. A piece about the size of a walnut is sufficient for the average size

of pot, and should be added in small portions at a time, the metal then being vigorously stirred. The oxide of aluminium is then found on the surface as a dry, fine powder, which is readily skimmed off.

Melting Scrap.

Scrap aluminium, particularly fine and small stuff, is very difficult to deal with satisfactorily on account of the oxidation which takes place and the consequent dross on and in the metal. Sometimes chips, etc., can be melted by adding to a pot of molten metal, but even then there is a danger of getting dirty metal. Every care should be taken to pack the scrap as closely as possible to exclude air and to protect it during melting.

The difficulty of obtaining sound metal when re-melting scrap aluminium may be illustrated by the attempts that have been made to re-melt scrap sheet-metal for rolling into sheets—a class of work which, of course, demands thoroughly clean, sound metal. This was attempted by a good many firms a few years back, but with absolute failure in practically every case. This resulted from the fact that the oxide which formed during the melting down of the sheet scrap, being no lighter than the molten metal, remained entangled therein and was consequently poured with the metal into the cast plates. These on being rolled cracked hopelessly, as might be expected, rendering it impossible to produce sheets therefrom.

Moulding.

Despite the fact that green sand moulds, which are usually employed for casting aluminium, allow of some shrinkage of the metal, cracking from shrinkage is a very common occurrence. This will frequently occur where the moulder is not used to the work, for the tendency is to ram the moulds too hard. It is the hardness of the dry-sand mould that rules it out for aluminium work, for not only is it more expensive, but it is far more liable to give a cracked casting than the softer green-sand mould.

It need not be impressed on moulders that the light ramming which is desirable in moulds for aluminium castings necessitates great care being taken to avoid drop-outs. In fact, this feature often means that gaggering has to be employed where it would be deemed entirely unnecessary in ordinary work; the moulder has to disregard all the rules for other work and consider just the necessity of getting a light, soft mould that will hang together sufficiently to take the metal.

As with some other classes of moulding where an open grain is desired in order to assist the escape of gases, it is good practice to make the body of the mould of a coarser and more open-grained sand than the facing sand. A fine grade of floor sand is best for large moulds, though if a very fine sand is used throughout the mould the tendency to clog and prevent the escape of the gases and cause blown castings is incurred. The ordinary type of flask is suitable for aluminium moulding, large castings being made in the floor.

Since the pouring temperature of the metal is so low, in order to prevent undue chilling, or, on the other hand, getting the metal too hot in avoiding this, the use of several gates and risers is recommended with castings of any considerable size or weight. These allow the metal in a properly molten condition to get to every part of the mould, and should be rather large than small. It is customary in some shops to chill the risers and gates after the mould is completely filled, by placing pieces of aluminium in them, the risers and gates being then broken off to allow the dumping of the casting to be freely done. The dumping of the casting should be carried out as soon at it is all set. As regards the risers on heavy parts, these should be sufficiently large to properly feed the casting, as small risers often do more harm than good.

Chill and Permanent Moulds.

Pure aluminium is more difficult to cast than many of the alloys, on account of the considerable shrinkage, though in some cases where lightness is of paramount importance the pure metal is employed. Where the shape of the casting, owing to the absence of awkward projections or complicated forms, allows the shrinkage to take place without distortion or cracking resulting. the trouble of shrinkage is greatly reduced. For such simple pieces of work, amongst which may be mentioned the reproducers of gramophones and talking machines—a class of article that has largely employed pure aluminium—casting into iron moulds has found considerable favour. This method gives a clean, close-grained casting, and if a large runner which will also act as a feeding-head is put on, very successful results can be obtained. But it will be readily conceived that the use of this method is broadly limited to comparatively simple castings. The moulds for this work should be made as clean and as smooth as possible, and warmed before pouring the metal in, to avoid undue chilling.

The restrictions which are associated with the use of iron or similar permanent moulds necessitate the use of green sand for the greater part of aluminium cast work, though recently a mixture of fine carborundum powder, sugar and clay (these latter as binding materials) has been adopted with success by some moulders. The thermal conductivity of carborundum has the effect of rapidly cooling the metal and giving dense castings of a fine structure. Unlike metal moulds, too, moulds of this material can be readily reduced to a powder again for re-use; nor do they involve the absolutely rigid features of a metal mould.

Cores.

The cores for an aluminium casting, if at all intricate, are really of more importance than the mould itself. They should on no account offer any material resistance to the shrinkage of the metal, and should be well vented to allow the escape of gases. The core generally used in the iron foundry is totally useless for aluminium work, as it is far too hard. The mixture employed with success by one American foundry consists of old and burnt sand, wet with molasses water. This, of course, makes a very tender core, and one that will stand no rough usage, but it is sufficiently hard to serve for aluminium work. There are numerous mixtures, however, that will serve equally well, the essentials being a fairly open sand that will give a clean face without being so hard as to withstand the pressure of the metal in cooling, and sufficient binder to keep it up while the metal is being poured. Coating with a core-wash is generally conceded by expert aluminium founders to be a mistake, as it closes the pores of the core and prevents the escape of the gases; neither is there the slightest necessity for it, on account of the low heat at which the metal melts and is poured.

The foregoing notes only summarise the chief points which have to be regarded, but it is hoped that to the practical man they will be sufficiently suggestive to assist in what is one of the most interesting branches of the foundry trade.

Foundry Plant and Equipment.

The Monarch Stationary Crucible Melting Furnace.

A pot furnace for handling crucibles for the melting of metals in such a way that the crucibles can be removed from the furnace, and used for pouring

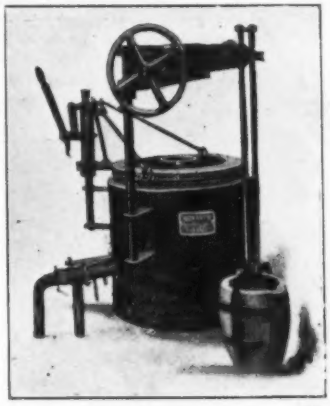


FIG. 1.—MONARCH CRUCIBLE FURNACES; CRANE IN POSITION FOR LIFTING POT.

metal, which has been placed on the market by the Monarch Engineering and Manufacturing Company, Baltimore, U.S.A., is illustrated herewith. Fig. 1

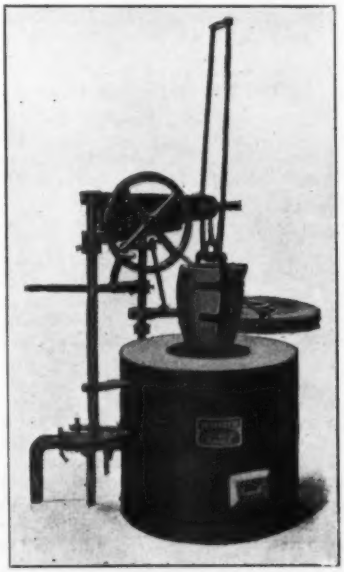


FIG. 2.—CRANE SWUNG OVER FURNACE READY TO LOWER POT.

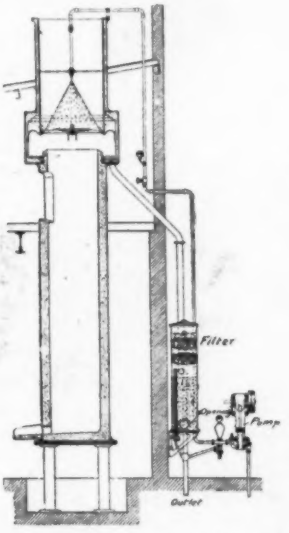
shows the furnace with the cover in place and the adjustable crane in position to pick up the pot by means of the lifting tongs. This crane is a feature of the stationary furnace, and is found very useful in placing pots into the furnace and in removing them. It works by a chain which is wound up on a small drum on the spindle of the hand-wheel shown.

The pot is lifted from the position shown in Fig. 1 to that shown in Fig. 2. The cover is then swung to one side, the pot swung over the furnace and lowered into the melting position. The opening in the top of the cover of the furnace serves for the escape of the products of combustion and also for introducing material into the pot after it is in the furnace, or for inspecting the condition of the metal as it melts.

These furnaces can be arranged to set in pits or set above the floor, and are also furnished with or without the lifing crane shown in the illusrations.

Purifier for Cupola Gases.

The sparks, dust, etc., which are given off when working a cupola often prove troublesome and involve the erection of spark chambers or special flue arrangements. An apparatus has, however, been



PURIFIER FOR CUPOLA GASES.

designed by H. Hammelrath & Company, G. m. b. H., Cologne-Lindenthal, for precipitating the sparks and flames at the top of the cupola, by means of a jet of water. Depending on the quantity of water used, the sulphur fumes also may be so precipitated. The appliance consists of an arrangement for producing a broad conical sheet of water. The drops of water, as shown in the illustration, rebound on a metallic plate projecting beyond the upper edge of the spherical furnace, are reduced to a fine spray, and are then thrown back by the plate as very fine bubbles. They then fall past the edge of a convex plate to an open channel surrounding the upper edge of the furnace.

The apparatus is said to very successfully serve the purpose for which it was designed.

A Sand Mixing Machine.

The quality of sand for moulding purposes depends not only on the ingredients, but on the way in which they are incorporated and mixed together. It is also important that the sand should be thoroughly exposed to the air or aerated, so as to render it light and loose in texture and of even temper. The machine illustrated herewith was designed to obtain efficiently mixed sand. With this machine all lumps are crushed and the sand riddles much more easily, thus saving a great deal of time in moulding. A great economy also results from the fact that the sand does not need to be milled before mixing.

SAND MIXING MACHINE.

The machine consists of a pedestal carrying two vertical spindles rotating at high speed, one within the other. The spindles are driven in opposite directions by bevel gearing from a pulley on a horizontal shaft. The upper ends of the spindles carry two intermoving cages, the bars of which, passing each other in opposite directions at a great speed, do the mixing and disintegrating. The cages are covered by a dome-shaped casing which directs the mixed sand on to the floor, and prevents it from flying about. The centre of the dome carries a hopper, into which the unmixed sand is fed, and from which it drops into the centre of the cages. It is delivered in a circular heap round the apparatus.

The machine is stated to deal with all the sand two men can shovel, and 7 cwts. per minute is given as a moderate figure for general practice. The makers are Messrs. Alfred Herbert, Limited, Coventry, who originally designed this mixer for use in their own foundry, where it was found to be very successful.

A Comprehensive Wood Worker.

One of the most important branches of engineering is unquestionably the pattern-shop. It is of the greatest importance that pattern work should be accurately done, and not less desirable that it should be quickly done. At the present time the difficulty is not so much with regard to the accuracy of the work as the slowness of its production. It is so very easy for a man to spend an unreasonably long time over a pattern on the plea that it must be carefully and accurately made, and a great deal of avoidable expense is the result. Any invention in the direction of machinery which will produce accurate work and allow the more difficult classes of pattern-work to be produced more quickly, must therefore be a welcome addition to the equipment of a large pattern-shop.

We illustrate herewith a comprehensive wood-worker which has evidently a wide range of usefulness. By the use of this machine, it is claimed, a great deal of the usual work of a pattern-shop now produced by hand can easily be machined in one-tenth of the time usually required. Cone-boxes, globe valve-boxes, and general pattern-work, grooving,

slotting, boring, moulding, half-lapping, and circular and curved work can be done with the greatest facility.

Briefly, the machine consists of a horizontal spindle on a fixed pedestal, and a work-carrier or stand, in which are combined so many movements as to be practically universal. The pedestal carrying the spindle is bolted to the bed-plate, and is driven with a belt, by the pulley shown on the extreme right in Fig. 2.

The work-carrier has for its foundation a four-legged stand, resting on "V" guides on the bed-plate. This is controlled by a leading screw and hand-wheel, and allows the work-carrier to be adjusted for large or small work. Guides are formed on the top of the stand for a compound-slide, moving to and fro in the line parallel to the axis of the spindle; this allows the most delicate adjustment, and for feeding the work against the cutting-tools and regulating the depth of cut. The movement is controlled by the lower hand-wheels, shown between the legs of the stand.

Resting on the compound-slide is a table with a vertical quadrant, the face of which is towards the spindle. This table has a movement at right angles to the axis of the spindle, and is controlled by the hand-wheels on either side, which are shown above these controlling the compound-slide. On the flange of the quadrant teeth are cut. The face of the quadrant carries a long guide or rest, which is pivoted on the centre of the quadrant, and held in position by a locking bolt. This guide or rest is shown horizontally in Fig. 1, and at an angle in Fig. 2, and forms one of the chief features of this machine. It carries a slide which can be adjusted at any position along the guide by means of the screw and hand-wheels shown on either side of the upper part of the guide. The guide can be adjusted at any angle.

To the slide in the guide is bolted either a circular work-table or the horizontal work-table, shown in Fig. 2. The horizontal work-table is constructed so that it may be held horizontally no matter what angle the guide may be set at. It is provided with guides, clamps, and springs, for holding the work in position. Work of any length may therefore be operated, and grooves cut at any angle, although the work constantly stands in a horizontal line. The circular work-table is used for cutting core-boxes, and for circular or curved grooves, mouldings, etc. It is fixed to the slide by means of a strong pivot bolt, on which it revolves. On the flange of the table teeth are cut, by which it is revolved by a worm-wheel connected to the small hand-wheels shown on either side in front of the slide-rest.

The guide and slide are fitted with a scale and pointer so that the work-table can be quickly centred when required for circular work. The lower arm of the horizontal work-table is provided with adjustable markers for setting off parallel grooves, and it is unnecessary to mark off more than the first two of a series of equi-distant grooves. The various angles are marked on the quadrant so that grooves or cuts at a required angle can be easily arranged. Adjustable stops are provided by which the length of a cut can be regulated for repetition work.

Owing to the head-stock being a fixture, much greater power can be obtained than when the head is moveable, and cuts of 3 in. to 5 in. diameter and 2 in. to 3 in. deep can be made in one operation at the rate of three to four feet a minute. The machine weighs about 24 cwts., and occupies a space of 7 ft. 6 in. by 4 ft. The makers and patentees are Messrs Robt. S. Allan & Company, wood-working engineers, of Gateshead-on-Tyne.

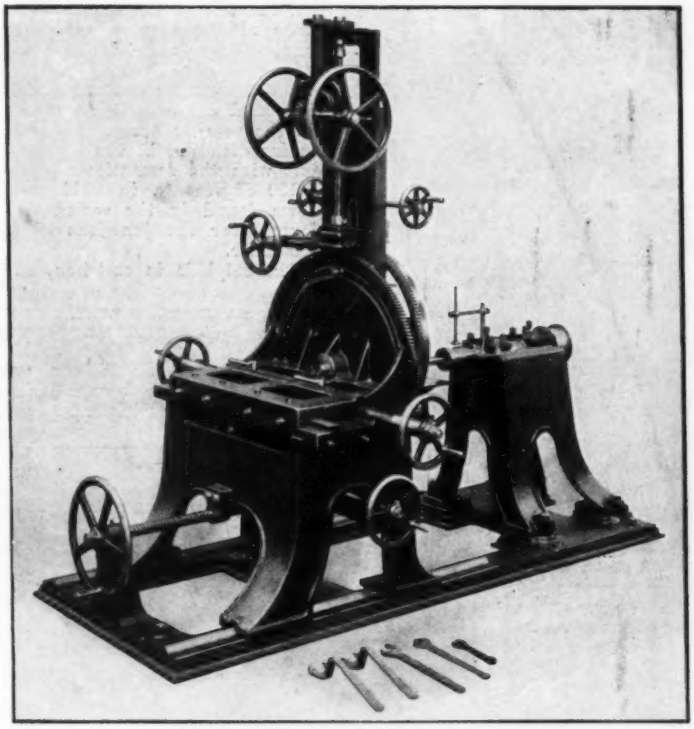


FIG. 1.—ALLAN'S WOOD WORKER.

Manganese Sulphide in Iron and Steel.

At a meeting of the Staffordshire Iron and Steel Institute last month, at Dudley, a Paper bearing the above title was read by Mr. Donald M. Levy, A.R.S.M. The author referred to the valuable researches on the subject already undertaken by Mr. J. E. Stead, Professor Arnold, and Professor Le Chatelier, and explained that an object of his Paper was to connect the observed facts regarding manganese sulphide with those general scientific principles which have become so useful in assisting those engaged in the iron and steel industries to understand more clearly what is happening to the metal under the varying conditions of works practice. He pointed out that there are three important factors which, among others, determine the condition and distribution of the manganese sulphide:—(1) Its melting point; (2) its solubility and the proportion present; (3) the composition of the cast irons and steels of which it is a constituent. A summary of the author's conclusions is appended:—

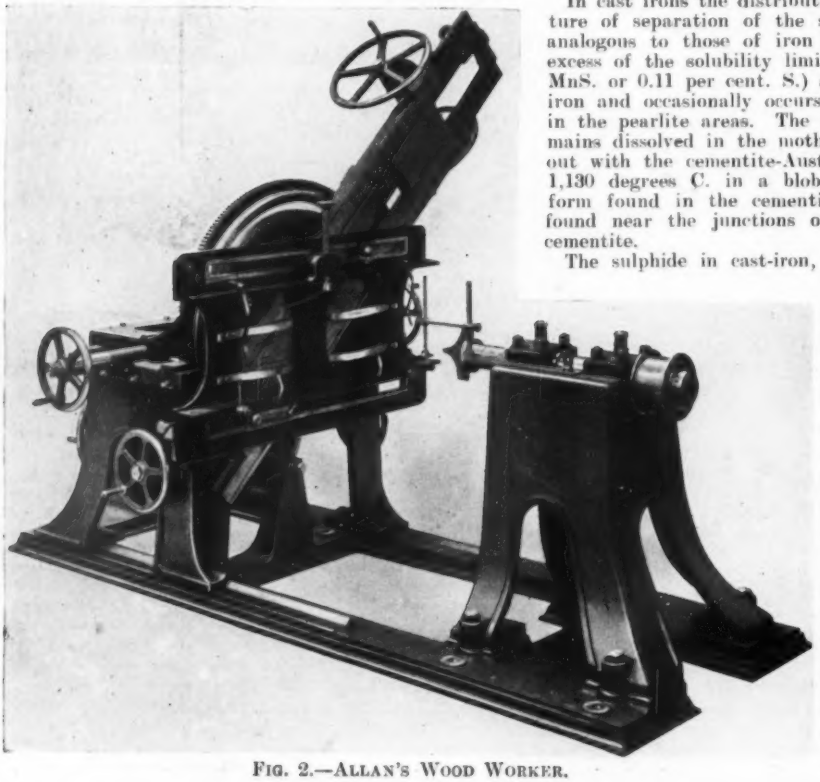


Fig. 2.—Allan's Wood Worker.

Pure manganese sulphide has a melting point somewhat lower than pure iron; about 1,400 degrees C. is suggested tentatively.

In steels the manganese sulphide is not always pure, but often contains varying quantities of iron or manganese according to the composition of the steel. Such manganese sulphide has naturally a markedly lower melting point than the pure substance. The variation in colour of such impure manganese sulphides can be observed microscopically.

Though the bulk of the manganese sulphide tends to separate from steels, some is retained in the liquid metal, and solidifies after the steel has become solid. It separates at the boundaries of and between the primary crystals, and is hence found in the ferrite areas in low-carbon steels and in the cementite borders of high-carbon steels, removed from the pearlite areas. It occurs in the form of blobs, globules, broken meshes, etc.

In cast irons the distribution, form, and temperature of separation of the sulphide are somewhat analogous to those of iron sulphides. Sulphide in excess of the solubility limit (about 0.30 per cent. MnS. or 0.11 per cent. S.) solidifies before the cast iron and occasionally occurs as primary crystallites in the pearlite areas. The rest of the sulphide remains dissolved in the mother liquor and separates out with the cementite-Austenite eutectic at about 1,130 degrees C. in a blobby or broken mesh-like form found in the cementite areas. It often is found near the junctions of the pearlite and the cementite.

The sulphide in cast-iron, as the manganese proportion decreases, shows a compound structure of MnS. and FeS., the manganese sulphide often being in the form of dove-grey crystals embedded in globules of yellow-brown iron sulphide. The compound sulphide behaves more and more like iron-sulphide in cast-irons, the lower the manganese contents.

Such double sulphides occur when the proportion of manganese in the cast-iron is insufficient to combine with all the sulphur present to form MnS. Some excess of manganese is necessary to ensure the whole of the sulphur being present as MnS. only, due in part to some of the manganese existing in other forms of combination—such as oxide or silicate, which leaves an equivalent quantity of sulphur free to combine with iron.

Sulphide of manganese is shown to be soluble in silicates, and the efficient removal of sulphur by manganese in mixer practice is explained by this fact.

Chemical analysis is shown to be insufficient for a proper knowledge of the metal for many purposes, since it does not give sufficient data as to the condition in which the dangerous impurities occur. Microscopic examination is especially valuable in this respect, giving information as to the form, bulk, and distribution of such constituents.

F.T.J. Bookshelf.

Fuel and Refractory Materials.

By A Humboldt Sexton, F.I.C., F.C.S., etc. London: Blackie & Sons, Ltd., 50 Old Bailey, E.C.

While this is, perhaps, not to be classed as a foundry book, yet fuel and refractory materials play a sufficiently important part in the working of a foundry for the subjects to be of interest to all progressive foundrymen. It is of the greatest assistance to all users of metallurgical furnaces to know the nature and properties of the fuels being used, particularly when the question of economy has to be studied as closely as is the case in most foundries. The quality and heat resisting properties of the refractory materials used in constructing the furnace and for repair work are also of vital interest if satisfactory working is to be obtained, for a bad lining to a furnace may start a series of troubles that it is difficult to overcome without considerable loss. This book, then, will be of direct service to the foundryman. Since the first edition was published it has not been found necessary to make any alteration in the general arrangement of the book, but considerable additions have been made, owing to the changes and developments in connection with coke-ovens, gas producers and pyrometry especially. All the subjects touched have been brought thoroughly up to date and the modern forms of plant described. A most instructive chapter on combustion occurs in the opening, followed by one on the heating power of fuels. The properties of wood, peat, and coal are then dealt with, after which are considered solid prepared fuels, such as charcoal, peat-charcoal and coke. The objects of and apparatus for coal washing are then briefly dealt with, after which the author passes on to the subject of liquid fuels. On the question of the future of oil fuels, the author considers that as they become better known they will be more largely used, but he does not think it likely that they will supersede coal, either directly or through the form of gas. Gas fuels form the subject of a very instructive section in which a considerable number of different gas producer plants of various designs are briefly described and illustrated, while about 15 pages are also devoted to the subject of the recovery of by-products. Furnaces for various metallurgical purposes, not excluding boiler furnaces, are treated in another section, the essential features of the different forms of furnace being briefly but graphically explained. Pyrometry and calorimetry, which have experienced considerable changes and advances during the last few years, have been dealt with in a manner that will commend itself to the practical man, while the chapters on the utilisation of fuel and the testing of fuels are also very useful. The final portion, dealing with refractory materials, bricks, crucibles, etc., contains a lot of valuable information and is clearly and concisely written. It will be seen from the foregoing that the book embraces a wide field; and we may say that it treats the different subjects very thoroughly considering the limitations of space that are naturally imposed upon a hand-book of this nature.

The Journal of the Institute of Metals. Vol. II.

Edited by G. Shaw Scott, M.Sc., Secretary. London: The Institute of Metals, Caxton House, Westminster, S.W.

This volume contains the record of the proceedings of the autumn meeting of the Institute, held in Manchester on October 14 and 15 last. Each paper is followed by a very full discussion, to which a large number of eminent scientists have contributed since the verbal discussion took place. As compared with Vol. I., the present volume is improved by the addition of a completely new section which is devoted to abstracts of papers relating to the non-ferrous metals and the industries connected therewith. It is anticipated by the Council that this section of the "Journal," the preparation of which has evidently necessitated a considerable amount of labour and research, will constitute one of the most valuable features of the publication. We understand that practically the whole of the technical publications of the world in all languages have been searched for articles of scientific interest bearing upon the metallurgy of the non-ferrous metals and their alloys. Certainly a very useful and important selection of abstracts has been compiled, and will add considerably to the value of the volume.

Journal of the Iron and Steel Institute. Vol. LXXX.

Edited by George C. Lloyd, Secretary. London: E. & F. N. Spon, Limited, 57, Haymarket.

This volume of the Institute's "Journal" contains the proceedings of the autumn meeting, held in London in September, 1909, together with the papers read and the discussions and correspondence thereon. An illustrated account of the visits, excursions and entertainments connected with the meeting is also included, and, in addition, a report of the Congress of the International Testing Association, held at Copenhagen in September last. The other usual items and the record of progress of the home and foreign iron and steel industries during the second half of 1909 occupy the remaining portion of the volume.

The Encyclopædia of Practical Engineering and Allied Trades.

Edited by Joseph G. Horner, A.M.I.Mech.E. London: Virtue & Company, 7, City Garden Row, City Road.

The tenth and final volume of this useful work is well up to the standard of the previous issues. It covers the field from T (tin) to Z (zinc), and includes a number of excellent plates and line drawings. Such important subjects as turbines and turbine pumps are very fully dealt with, about 15 pages being allotted to the two mentioned. Other references receive corresponding treatment, making the whole work quite a comprehensive one.

Publications and Catalogues Received.

Trier Brothers, Caxton House, Westminster, S.W. An illustrated catalogue dealing with lubricant, lubricators, grindstone-dressers and engineering appliances.

The Vincit Company, Limited, 67, Aldersgate Street, London, E.C. An illustrated catalogue of carborundum and "electrite" goods, and high-class grinding materials, wheels, etc., has been forwarded by this firm of manufacturers.

The North British Lifting and Moving Appliances Company, Limited, 56 and 58, Robertson Street, Glasgow, have forwarded a copy of their catalogue of general and special lifting and moving appliances and accessories, amongst which are a number excellently adapted for foundry use.

Carbon: Its Properties and Relation to Cast Iron.

Before the Lancashire Branch of the British Foundrymen's Association recently, Mr. R. H. Greaves, B.Sc., read a paper on the above subject, an abstract of which is given herewith :—

Iron and carbon are a pair of elements of wide distribution in nature, and of the greatest value in the arts, and though remarkable individually, are still more so in conjunction. Carbon occurs in three distinct forms, two of which are crystalline and one amorphous. The crystalline forms, diamond and graphite, may both be prepared artificially, and are products of the electric furnace; the latter is also obtained by the crystallisation of carbon from solution in iron. The gradual addition of carbon to iron converts it into steel, while, after 2.3 per cent. is exceeded the product is called pig-iron. Just as rocks are made up of minerals, so these iron-carbon alloys are formed of definite constituents. Those which may occur in steel are :—

(*a*) Ferrite, consisting of crystals of pure iron, which under the microscope, show well-defined facets and angles.

(*b*) Cementite—a carbide of iron represented by the formula Fe^3C. This is a crystalline substance of great hardness; its presence diminishes the ductility of steel, the tensile strength being first increased by the stiffening action of the carbide, and then diminished.

(*c*) Pearlite, consisting of alternate layers of cementite and ferrite. Steels with less than 0.89 per cent. of carbon are composed of ferrite and pearlite; those with more than 0.89 per cent., of pearlite and cementite. Quenched steels may show two distinct structures.

(*d*) That known as austenite, when quenched rapidly from a high temperature (1,000 degrees C.). (This is possibly a solid solution of carbide in iron).

(*e*) That known as martensite, which occurs in all hardened steel, and is probably composed of an unstable carbide of iron Fe_4C of intense hardness, associated with either ferrite or cementite.

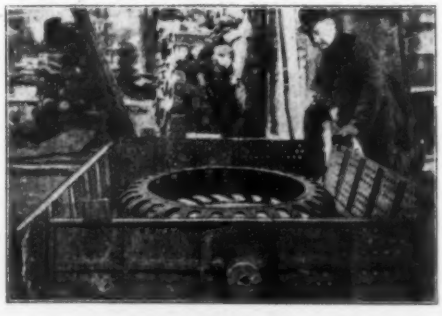
The constituent $Fe_{24}C$ is known as hardenite, and if slowly cooled it breaks up into pearlite at 690 degrees C. Since cast iron is only a highly carburised form of steel, the same constituents may appear under suitable conditions. In addition there may exist in cast iron free carbon in the form of coarse-grained graphite or of annealing carbon sometimes known as temper graphite.

Thus there are at least four or five different modes of occurrence of carbon in cast iron, and as chemical analysis only distinguishes two of them (combined carbon and graphite) it is not surprising that it often fails to indicate the physical and mechanical properties. The constituents depend on the rate of cooling. A cast iron containing between 2.3 and 4 per cent. of carbon, when quenched contains cementite and hardenite. Quickly cooled, cementite separates as cooling goes on, and hardenite is partially changed into pearlite at 600 degrees. The more cementite and hardenite present the whiter and harder is the iron. Slowly cooled, immediately after solidification contains graphite associated with cementite and hardenite, which on cooling deposits finely-divided carbon, and finally the remaining hardenite breaks up into pearlite at 690 degrees.

Some authorities maintain that with long annealing and slow cooling, a cast iron is resolved into ferrite and graphite. In practice every grade between this and white iron is encountered. The separation of finely-divided carbon is of great importance, and this is the form taken by carbon in annealed castings. Irons containing carbon in this form have a more close texture and consequently greater strength than in those containing close coarse-grained graphite. In practice, results are complicated by the presence of other elements, such as manganese, silicon, sulphur and phosphorus. The above statements have referred to an ideal case, the consideration of which is, however, absolutely necessary to form the basis for the metallurgy of cast iron.

A New Moulding-Box System.

A new moulding box system has been devised and patented by A. Zenes, of Charlottenburg, Berlin, whereby it is possible to produce a moulding box of any shape and size, in a few minutes, by combining single walls. The illustration depicts the putting together of a separable moulding box according to this method. The front and side walls are connected by means of projections which extend into cavities in the side walls, and by means of nose-like arrangements displacement of the sections of the box is obviated. The front or side walls can be arranged to give any required size or shape of box. The putting together is a very simple matter, and not only can square or rectangular boxes be so constructed, but also round ones, in two or more parts, according to the demands of the work.



A New Moulding-Box System.

Inventions.

Applications for Patents.

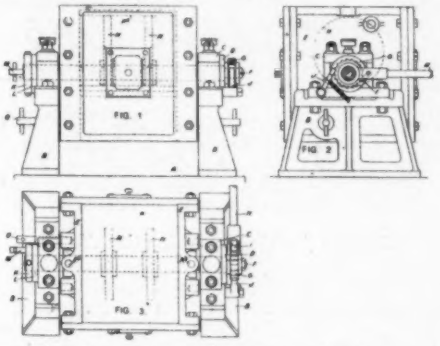
An asterisk indicates that a complete specification accompanies the application. When inventions are communicated the names of the communicators are in brackets.

1,189.*Electric furnaces. J. H. Reid.
1,220. Condenser for zinc-smelting furnaces. E. H. Hopkins.
1,305. Furnaces and furnace doors. J. Smalley.
1,510.*Sand blasting apparatus. L. Gabillard, 9, Warwick Court, Gray's Inn, London.
1,906.*Regenerative furnaces. J. Kros.
1,912.*Apparatus for rubbing or filing tramway or railway metals. O. Haase, 31, Bedford Street, Strand, London.
2,130.*Cupola furnace. A. Baillot.
2,166. Portable crucible furnaces. M. Harvey.
2,337. Apparatus for cast steel ingots or other mould bottoms to solidify cast steel ingots, etc. W. Mayer, Morwell House, Oxhill Road, Dumbarton.
2,439.*Furnaces. T. F. F. Lee.
2,653. Heating of air for metallurgical furnaces. W. G. Perkins and W. M. Barker.
2,661.*Moulding machines. J. Barker.
2,759. Treatment of metals. (General Electric Company, United States.)
3,306.*Process for making casting-moulds from pattern with inward-projecting corners on moulding-machine without appliance of cores. H. Rühl, 345, St. John Street, London.
3,421.*Supplying electric furnaces with polyphase currents. Société Anonyme Electro-Metallurgique (Procédés Paul Girod).
3,739.*Metallurgical furnaces. J. Härdén.

Abstracts of British Patent Specifications recently accepted.

26,380 (1908). *Manufacture of Metallic Alloys.* Dr. Dagobert Landenberger, 14, Gitschiner Strasse, Berlin, S.W., 61, Germany.—This invention relates to an improved process for the manufacture of metallic alloys consisting of copper and zinc with such metals as iron, chromium, manganese, tungsten, nickel, cobalt and vanadium, which enables a material of high technical value to be produced at a relatively low cost. In accordance with the process under the present invention a chromium-zinc-copper alloy may be made as follows:—A quantity of the chloride corresponding to the desired percentage of chromium in the final alloy is taken and this chloride is reduced by zinc, the chromium liberated becoming alloyed in the nascent state with the zinc present in excess. The chromium-zinc alloy thus obtained is then melted and mixed with an appropriate quantity of copper.

21,232 (1908). *Foundry and other Moulding Machines to be Operated by Hand or otherwise.* J. H. Topham, 24, Idsworth Road, Sheffield.—The invention relates to moulding machines for foundry purposes, in which the movement of the pattern is used to effect the ramming of the sand. In building a machine the design may be varied from rectangular to circular shape. Fig. 1 is a sectional elevator of a rectangular machine; Fig. 2 is an end elevation of same; and Fig. 3 a plan of same. Upon a base A, two standards B are fixed in opposite positions, each provided with a pedestal C, or like bearing to support the trunnions D, of a rectangular metal box or casing E, open at the top and bottom and capable of being turned over upon its trunnions when required. Through both the trunnions and the body of the casing, is passed a shaft F, having upon one of its projecting ends a ratchet wheel G, with its lever H, and pawl I, with a second pawl J, pin-jointed to the pedestal to prevent a retrograde movement of the shaft F. Upon the opposite projecting end of the shaft is a firmly fixed collar K, which can be secured to the trunnion collar L by means of a sliding pin M passed through the two parts. When this is done the outer casing is coupled to the shaft F, and can be turned with it. A similar device, namely, a sliding pin or bolt O, is used for connecting the outer casing E rigidly to the standards B when in a vertical position. Within the outer casing, which has its inside facings machined for the purpose, is fitted a second box P, capable of a sliding action therein both up and down. Upon the

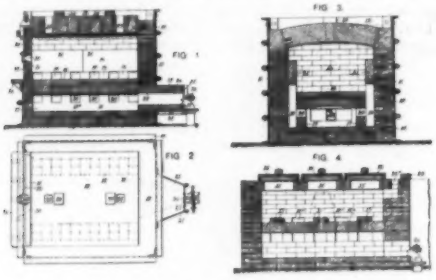


Foundry and other Moulding Machines to be Operated by Hand or otherwise.

shaft F, and within the inner box P, are fixed two facsimile eccentric cams N, their peripheries being in contact with paths formed upon the inner faces or both the top and bottom plates P^2, of the sliding box, so that when the eccentric cams are turned by operating the shaft F, the inner box is caused to slide within the outer casing towards one end or the other as the case may be. The pattern from which a mould or matrix is to be made in sand, is preferably secured upon a pattern plate which is affixed to the top plate P^2, and closely above this the moulding box is carried by the outer casing to which it is secured by bolts or their equivalents passed through the holes P^3, Fig. 3.

15,400 (1909). *Furnaces for Uniformly Heating Meta'.* —W. N. Best, 229, Ryerson Street, New York, U.S.A.; E. Best, 238, South Twelfth Street, Quincy, Illinois, U.S.A.; and J. H. Best, 907, Spring Street, Quincy, U.S.A.—Figure 1 is a vertical longitudinal section through a furnace constructed in accordance with the invention; Figure 2 is a top plan view; Figure 3 is a vertical transverse section; and Figure 4 is a vertical longitudinal section showing a slightly modified form of furnace. An outer shell or casing is formed of channel irons 10 having their flanges bolted or riveted together, and inside of this casing are provided thick side walls 11 of highly refractory material. The side walls support an arched roof 12, which terminates adjacent to an end wall 13, and between the side walls at the bottom is a floor 13^a. The interior of the furnace is subdivided into a heating chamber 14, adapted to receive the articles to be heated, and a heat-distributing chamber 15 directly below the same. The two chambers are separated by a horizontal partition or floor 16 which directly supports the articles to be heated, and is itself heated by the exposure of the under side to the heat-distributing chamber below. The floor 16 is supported upon inner side walls 17, substantially parallel to the main side walls 11, but spaced therefrom. This space is subdivided by vertically-extending blocks 18, so as to leave vertical passageways 19 extending upwardly between the edge of the floor 16 and the side walls. These passageways 19 communicate with the heat-distributing chamber through openings 20 in the walls 17, but above the lower edges of the latter. The passageways 19 communicate at their upper ends with the interior of the heating chamber 14, and the gases are deflected outwardly from the passageways 19 by lining blocks 21,

resting upon the tops of the spacing blocks 18. At one end of the furnace there is provided a combustion chamber 22, substantially triangular or fan-shaped in horizontal section, and having its inner end of nearly the same width as the distributing chamber 15, and communicating therewith. The combustion chamber may be formed by parallel top and bottom walls 23, and converging side walls 24, extending out beyond the outer surface of the end wall 13, and held in place by a metal

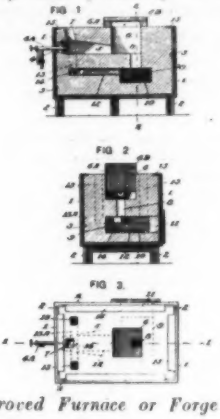


Furnace for Uniformly Heating Metals.

reinforcing casing 25. At the outer end of the combustion chamber there is disposed a burner, from which the flame and gases of combustion enter the combustion chamber, and spread out or diverge to the entire width of the distributing chamber. The combustion chamber is centrally located, and as the gases emerge therefrom they pass along the several entrance openings 20 in the inner side walls 17, and thence upwardly through the passages 19 to the main heating chamber. The floor 16 is heated from the under surface, and the interior of the furnace is heated by the large number of streams of flame or gases of combustion entering laterally along the sides.

28,508 (1908). *Treatment of Alloys of Tin and Copper to Separate the Metals.* C. H. Stewart, 4, Broad Street Place, London, E.C.—The invention consists broadly in smelting the alloy with material adapted to supply oxygen to the tin, sulphur to the copper, and a base to the oxide of tin so as to obtain a stannate of the base and a copper matte. The alloy is preferably granulated and may or may not receive a preliminary oxidising roasting. Both sulphur and oxygen may conveniently be supplied together in the form of a suitable sulphate, and if this be calcium sulphate, sodium sulphate or the like, or a mixture thereof, the base will be furnished at the same time. The interchange of elements is facilitated by slightly reducing conditions and some form of carbon, preferably as crushed coke, should be present in the charges, although the proportion need not be large. Thus the charge may contain sufficient calcium and sodium sulphates to furnish sulphur to combine with nearly all the copper in the charge, to provide oxygen to combine with the tin and to provide oxides of calcium and sodium to combine with the oxide of tin to form fusible stannates. As a typical example the following figures may be given for an alloy containing 45 per cent. of copper and 50 per cent. of tin. A furnace charge containing such an alloy may have the following composition:—Alloy, 20 cwts; sodium sulphate, 5 cwts.; calcium, 6 cwts; sodium carbonate, 6 cwts.; sand, 5 cwts.; crushed coke, 35 lbs. The product from the smelting furnace will be:—Copper matte, 8 cwts; Copper, 72 per cent.; tin, 3 per cent. Bottoms, 5 cwts.: Copper, 49 per cent.: tin, 22 per cent. Stannate slags, 24 cwts.: Tin oxide, 45 per cent.; lime, 10.3 per cent.; soda, 23.2 per cent.; silica, 20.8 per cent.

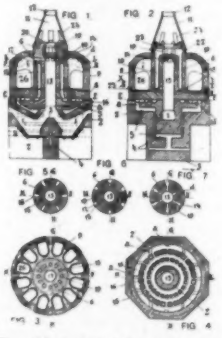
14,059 (1909). *Furnaces or Forges.* W. Scrimgeour, 251, Main Street, Norfolk, Virginia, U.S.A.—This invention relates to furnaces or forges utilising oil or gas as fuel, and that class which includes a refractory setting having a heating chamber therein, with which the burner communicates, and from which leads a vent flue returning to the forward part of the furnace. The essential feature is a construction which permits the use of the waste gases to maintain the temperature of the oil or gas combustion chamber, which is separate from the heating chamber, but in communication therewith, thus producing substantial evenness in heating effect. For these purposes a vent flue is provided, extending from the bottom of the heating chamber, and in sufficiently close proximity to the combustion



Improved Furnace or Forge

chamber to maintain its temperature, and a branch flue extending upwardly within the masonry wall in proximity to the combustion chamber. Figure 1 is a longitudinal vertical section through the furnace on line 1—1 of Figure 3; Figure 2 is a transverse section on line 2—2 of Figure 1; and Figure 3 is a plan view of the furnace.

5,549 (1909). *Gas-fired Melting-furnaces.* C. Deselle, 27-29, Avenue de la Gare, Persan by Paris, France.—The invention relates to improvements in annular gas-fired melting-furnaces with a central pillar, wherein the gas passes from a central column communicating with a cylindrical chamber surrounding the flue, and wherein an annular combustion chamber surrounding the flue is provided. This invention also relates to the type wherein the fire space or hearth is formed of an annular chamber with a corresponding vaulted roof and centrally



Gas-fired Melting Furnace.

placed pillars. The essential features consist in the particular arrangement of the gas outlets, the air channels and the suction channels. Figure 1 is a vertical section of the furnace on the line G H of the Figures 3, 4, 5, 6 and 7; Figure 2 is another vertical section on the line M N in the Figures 3, 4, 5, 6 and 7; Figure 3 is a horizontal section through the line X Y in Figure 2; Figure 4 is a horizontal section through E F in Figure 1; Figure 5 is a horizontal section of the central pillar through the line S T of Figure 2; Figure 6 is a horizontal section of the central pillar through the line P R of Figure 1; Figure 7 is a horizontal section of the central pillar through the line K L of Figure 1.

Trade Talk.

MR. J. F. GASKELL, engineer, etc., has established a branch in Scott Street, Hull.

THE BRITISH HELE-SHAW PATENT CLUTCH COMPANY, LIMITED, have removed to Suthers Street, Oldham.

THE SANDYCROFT FOUNDRY COMPANY, LIMITED, have removed their London offices from 6 to 9, Queen Street Place, E.C.

THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED, of Rugby, have opened a branch office at Royal Chambers, Cardiff.

THE liquidator of the Metallic Manufacturing Company, Limited, intimates that a first dividend will now be paid to the creditors.

BUCK & HICKMAN, LIMITED, of London, Birmingham, etc., have severed their connection with the Halesowen Steel Company, Limited.

RECENTLY a fire broke out at the works of Messrs. J. & J. Wiggin, casters, etc., Old Hall Works, Bloxwich. The damage was not serious.

MR. A. W. MATHYS has started in business at 43, Chancery Lane, London, W.C., as a consulting engineer and chartered patent agent.

MR. V. O. CUTTS has established himself in business at the Town Hall Chambers, 87, Fargate, Sheffield, as an electric power and lighting engineer.

J. WARNER & SONS, LIMITED, have removed their offices from 2, Jewin Crescent to the Crescent Foundry, Spelman Street, Spitalfields, London, N.E.

THE KEY ENGINEERING COMPANY, LIMITED, inform us that they have, for the sake of convenience, transferred their Manchester offices to their works at Trafford Park.

WAILES, DOVE & COMPANY (1906), LIMITED, 5, St. Nicholas Buildings, Newcastle-on-Tyne, have opened a new branch office at 49, Blackfriars Street, Manchester.

MESSRS. S. PARSONS and A. RYLAND, tube manufacturers, etc., Cradley Heath, Staffs., trading under the style of Cartwright, Parsons & Company, have dissolved partnership.

MESSRS. G. SHEARD and F. R. POWER, Milford Haven, Pembroke, trading under the style of the Atlas Engineering and Ship Repairing Company, have dissolved partnership.

HULSE & COMPANY, LIMITED, Ordsal Works, Salford, Manchester, have appointed Messrs. Hartley and Hopper, 21, Mosley Street, Newcastle-on-Tyne, as their North-East Coast agents.

A DISSOLUTION of partnership is notified in connection with Messrs. U. Horsfall, J. Crowther, and E. O. Coulthard, electrical and mechanical engineers, Knott Mill, Manchester, who traded under the style of Willis & Company.

THE HALLAMSHIRE STEEL AND FILE COMPANY, LIMITED, Neepsend, Sheffield, have installed a new mill furnace. This has been built by William Kirkham & Sons, Limited, and embodies the latest improvements of the makers.

MR. T. G. HOWES THOMAS, lately in the Engineering Department of the London and South-Western Railway, has established himself in business as a consulting engineer, etc., at 47, Victoria Street, Westminster, London, S. W.

A DISSOLUTION of partnership is notified in connection with Messrs. C. Jorgensen and H. F. A. Wackerhagen, engineers, etc., South Shields, who traded under the style of the Continental Engineering and Ship Repairing Company.

CONSIDERABLE progress is now being made with the new works of the Midland Railway Carriage and Wagon Company, Limited, at Washwood Heath, who propose closing their Shrewsbury branch and centralising their business in Birmingham.

THE VULCAN FOUNDRY COMPANY, LIMITED, of Newton-le-Willows, have received an order from the Indian State Railways for 37 locomotives of large size. They are of a new pattern, and will have six wheels, coupled, and bogie tenders.

BROTHERTON & COMPANY, LIMITED, of Leeds, have again placed an order with Ed. Bennis & Company, Limited, Little Hulton, Bolton, for their stokers and self-cleaning compressed air furnaces. This order is for two stokers, etc., for an 8 ft. 6 in. boiler.

NORTON'S (TIVIDALE), LIMITED, have opened a London office at 145, Cannon Street, E.C., which will be in charge of Mr. C. J. Seaman, M.Inst.M.E., who recently resigned the position of general manager and managing director of Heenan & Froude, Limited.

MR. W. D. WANSBROUGH, the Midland agent for Robey & Company, Limited, Lincoln; Lee, Howl & Company, Limited, Tipton; Heenan & Froude, Limited, Worcester; and John Thompson, Wolverhampton, has transferred his offices to 43, 44, and 45, Exchange Buildings, Birmingham.

EDWARD LOMER & COMPANY, LIMITED, 110, Fenchurch Street, London, E.C., have been appointed by Messrs. Gauhe, Gockel & Company, of Oberlahnstein, Germany, their sole representatives in the United Kingdom for the sale of their builders' and contractors' machinery and appliances.

THE directors of the Simms Manufacturing Company, Limited, have decided to change the title of the Company to the Simms Magneto Company, and for this purpose it has been necessary to place the present Magneto Company into a purely formal liquidation in order to secure the change of title.

MESSRS. HALL & PICKLES, of Manchester, London, Birmingham, Newcastle and Swansea, have been appointed by the Halesowen Steel Company, Limited, sole selling agents of their bright line shafting. The other manufactures of the company will, as heretofore, be dealt with direct from the works at Halesowen.

MR. S. G. JAMES has been appointed agent for the Islip Iron Company, Limited, Thrapston, and has established himself in offices at Exchange Buildings, Birmingham. Mr. James was for upwards of twenty years with Messrs. Samuel Dickinson & Son, of Wolverhampton, and Messrs. S. Bantock, Dickinson & Company, West Bromwich, acting as manager for the last-named.

MESSRS. A. BLYDE & COMPANY, Wallace Steel Works, Sheffield, have received intimation from Sir J. Clifton Robinson, J.P., managing director and engineer of the Imperial Tramways Company, Limited, Stockton-on-Tees, that they have secured the contract for the twelve months' supply of their special "Crutch Brand" tool steel for making rail-cutting sates, cold chisels, smiths' tools, etc.

WORK is about to be commenced on the proposed Admiralty testing house in Sheffield. It will be a centre for Admiralty inspectors and others versed in the requirements of the Admiralty in the matter of steel, tools, and general stores and equipment for battleships, cruisers, etc., and will be fitted with modern appliances for testing the work done under contract by Sheffield firms.

AT the London Bankruptcy Court, recently, an immediate order of discharge was granted to Hampton Kirby Ingham. The debtor was partner in the firm of Catton & Company, steel founders, of Leeds, and upon its being transferred to a company he acted as a director. His failure was attributed to depreciation in the value of his shares in the company, and in the value of his interest in his father's estates. It was reported that a dividend of 13s. 10½d. in the £ had been paid on debts to the amount of £5,980.

A DISASTROUS fire occurred last month in the large electric power station at the Victoria Works, Wolverhampton, of Bayliss, Jones & Bayliss, Limited, completely destroying the building and the very valuable plant it contained, but the company were able to arrange for a large and immediate supply of electric energy, which enabled them to resume work in a few days. The company were,

therefore, able to carry on their extensive business as hitherto with but a slight interruption.

SUBSCRIPTIONS have been invited at par for an issue of £600,000 4½ per cent. first mortgage debenture stock of the Coventry Ordnance Works. The stock is to be secured by a trust deed constituting a first mortgage on the company's property at Coventry, a first mortgage on the company's factory at Scotstoun, with a floating charge on all the other property of the company except uncalled capital. The stock will be redeemable at par on July 1, 1950, or at the option of the company at any time after January 1, 1915, by annual drawings at 105 per cent., or by purchase at a lower price. The company was formed in July, 1905, and has since carried on a considerable business in ordnance at Coventry and elsewhere.

AT Wolverhampton County Court, recently, before Judge Howard Smith, Mr. W. Waldron (Brierley Hill) made an application under the Companies Act, 1908, on behalf of the Earl of Dudley's Round Oak Ironworks Company, Limited, for a winding-up order against the Hurst Ironworks Company, Limited, carrying on business at Wolverhampton. Mr. Waldron stated that the Hurst Ironworks Company was incorporated in May last under the Companies Act, with registered offices in Prince's Chambers, Wolverhampton. The nominal capital was £1,000, divided into £1 shares, and the amount paid up was £202. The petitioners were creditors for £68 4s. 11d., the price of goods sold and delivered to the company in September last, in respect of which sum judgment had been secured with £5 costs. As the judgment had not been satisfied the present application had to be made. His Honour made the order, and appointed the Official Receiver (Mr Sam Wells Page) as liquidator.

PARTICULARS have become public of an amalgamation of the following firms of steam and water fittings manufacturers:—Gaukroger, Sykes & Roberts, Limited, Halifax; Newman, Hender & Company, Limited, Woodchester; I. Storey & Sons, Limited, Manchester; and Martineau, Beames & Madeley, Limited, Birmingham. The object of this amalgamation is to reduce working costs, to enable the different firms interested to specialise on the various branches of the trade, and to improve works organisation generally. In common with many other branches of British manufacture, it has been found to be increasingly difficult of recent years to compete successfully against the foreign manufacturer, who specialises to a great extent, and the arrangement indicated above has been adopted as a sure means of effecting this end. It is explained that the amalgamation is "in no sense a combination for raising prices, and selling rates will be arranged on the lowest possible figures consistent with cost of production and the maintenance of first-class quality." The amount of capital represented by the firms is about £150,000. It is proposed to trade under the style of The United Brassfounders and Engineers, Limited, the headquarters of the concern being at Liverpool. Several other firms who are now considering the matter are expected shortly to be brought into the combination.

AT a meeting held on January 28 at the London Chamber of Commerce of firms representative of all branches of raw and manufactured metals, a Metal Trades Section, representing about 150 of the leading firms, was formally constituted. Mr. W. A. Walber (W. A. Walber & Company) was elected chairman, and Mr. C. Engholm (Henry R. Merton & Company, Limited) and Mr. James Whitby (George Warren & Company) deputy-chairmen. Attention was directed to the Board of Trade notice of the introduction of the Provisional Order embodying the Maximum Schedules of Port Rates on goods imported into and exported from the Port of London, as affecting the metal trades, a sub-committee being appointed to consider the rates in the schedules and to formulate any representations or objections for submission to the Board of Trade and the Port of London Authority. It was decided to invite the co-operation of various other associations and institutions connected with the metal trades with a view to common action on matters of mutual interest, and also at future meetings, to consider the following amongst other questions:—Foreign and Colonial tariff questions (classification, etc.), marking of tinplates (trade descriptions, etc.), railway rates and classification, and the appointment of arbitrators in metal trades disputes in cases not otherwise provided for under contract forms or agreement.

A MEETING of the creditors of Samuel Mason, Limited, brassfounders, Dale End, was held at Birmingham, on February 18, Mr. George C. T. Parsons, liquidator, presiding. Mr. Parsons explained that he was appointed by the trustees for the debenture holders as receiver and manager on January 7 last, and he was now carrying on the business with a view to disposing of it as a going concern. The statement showed that the total assets were £30,213, that being as a going concern, and including the balance-sheet value of the property, plant, and fixtures. Deducting preferential creditors, debenture debt, and the mortgage which existed, there was an apparent surplus of £4,060 over the total unsecured creditors, assuming that the balance-sheet values could be realised; but that was extremely unlikely, even if the business was realised as a going concern, while if the business was broken up it was unquestionable that there would be a very large deficiency. The dividend, if any, for the creditors would be a small one. The company was formed in the year 1896, and for the first five years of its trading appeared from the accounts to have made reasonable profits, but it became evident that a large contracting business which had been developed in Cambridge, and which had apparently yielded large profits, had been, in reality, creating losses. In his opinion the failure of the business was traceable directly or indirectly to the losses and the distraction caused by the Cambridge business. A reasonably good trade in taps, brassfoundry, and beer machines still remained, and it was his hope that the business might be realised as a going concern. It was agreed to appoint Mr. Parsons liquidator, and an informal committee of inspection was elected to work with him.

THE necessity for fresh legislation to check illegitimate dealing in metals has long been felt by manufacturers, and a movement is now on foot with a view to secure an Act which shall have a deterrent effect on such dealing. As a consequence of thefts of metals, a special conference, convened by the Birmingham and District Engineering Trades Employers' Association, was held in Birmingham on the 16th ult., at which a draft Bill was considered, the object of which is to prevent the theft of precious metals by providing that all persons melting them shall be licensed by the justices, and by certain provisions which will enable the police to seize precious metals suspected of being stolen or illegally obtained before they can be melted down. The provisions of the Bill are such as will not interfere with ordinary trade transactions or the liberty of individuals to deal with precious metals honestly obtained; but it is contended by those who should be in a position to know that there is a large amount of pilfering of small quantities of precious metal from manufacturers, dealers, and others, which are accumulated and then melted down. It is argued that all persons who carry on the business of melting down, casting, or converting any precious metals should be licensed by the justices for each of their separate places of business, and should be required to take a letter of advice or delivery note from the vendor of any precious metals and retain it for a period to be determined upon. Also that a register of all purchases containing a general description and the weight of each parcel of metal purchased should be kept, together with the name and address of the vendor and the hour of the purchase. It is also desired that quantities should be fixed, and that it should be an offence, carrying with it a heavy fine, if purchases of less than the specified quantities are made. Another provision that is desired is that purchases should be kept in the state received for at least 48 hours after the purchase. The engineers, brassfounders, and the Chamber of Commerce were represented at the meeting, and it was decided to promote a Bill in Parliament.

Deaths.

Mr. W. Simpson, of Messrs. J. Simpson & Son, engineers, Dewsbury, died recently, aged 61 years.

Mr. T. Somers, head of the Baker Blower Engineering Company, Stanley Street, Sheffield, died recently.

The death has occurred of Mr. T. C. Willey, of Messrs. J. Willey & Sons, steel manufacturers, Sheffield.

Mr. F. Miller, secretary of Holman Brothers, Limited, engineers, Camborne, died recently, aged 59 years.

The death is announced of Mr. A. Hunter, of Messrs. C. & A. Hunter, ironfounders, Stranraer, aged 78 years.

Mr. Archibald Jeffrey, of the firm of Messrs. Jeffrey & Company, engineers and boiler makers, Alloa, died recently.

Mr. W. Trodden, manager of the foundry department of Royles, Limited, Irlam, Manchester, died recently, aged 66 years.

Mr. J. C. Dobbie, chairman of the well-known instrument firm of Dobbie, M'Innes, Limited, Glasgow, and 39, South Castle Street, Liverpool, died suddenly last month, at the age of 45.

The death occurred at his residence, North Bailey, Durham, on February 19, of Mr. Charles Emmott, the chairman of Messrs. R. Stephenson & Company, shipbuilders and engineers, of Hebburn and Darlington.

The death is announced at his residence, Upland Hall, Forest Hill, in his 72nd year, of Mr. William Robert Green, M.I.Mech.E., who had been for upwards of half a century associated with the firm of R. Waygood, Limited, lift and crane engineers.

The death is announced of Mr. E. White, of Wolverhampton. The deceased was found shot in his office at the works of the New Brotherton Tube Company, Limited, Commercial Road, of which he was the managing director. He was 55 years of age.

Mr. J. H. Irwin, of Sunderland, a prominent member of the North-East Coast Institution of Engineers, died on February 19, at the age of 61 years. He was well-known in the North of England because of his long connection—severed some ten years ago—as managing director of the North-Eastern Marine Engineering Company.

The death took place, at Newcastle-under-Lyme, on February 19, at the age of seventy-nine, of Mr. C. H. Hardeman, who had been prominently identified with the iron trade of North Staffordshire. He was for many years manager of the remarkably successful undertakings of the late Mr. Francis Stanier, of Peplow Hall, father of Mr. Beville Stanier, M.P.

Mr. J. Hogg, managing director of Gibb & Hogg, Limited, Victoria Engine Works, Airdrie, died on February 18, after a brief illness. The deceased, who was in his seventy-fourth year, was a native of the district, and founded the business of Gibb & Hogg in 1866. The firm developed a large connection abroad in the making of engines, colliery, and mining plant.

Mr. William Milne, of the firm of William Baird & Company, Limited, died at his residence, Woodfield, Fallside, Bothwell, recently. A native of Aberdeenshire, Mr. Milne went to Glasgow a good many years ago, and in 1873 entered the service of Messrs. William Baird & Company as clerk. Latterly he acted as pig-iron salesman for the firm. Mr. Milne was about 64 years of age.

Mr. W. F. Smithers died at his residence, at North Ormesby, Middlesbrough, on February 21. Mr. Smithers, who was 56 years of age, started life as a draughtsman with the once prominent Middlesbrough firm of Messrs. Hopkins, Gilkes, & Company. A few years ago, in association with Mr. Jeynes, he founded the firm of Smithers & Jeynes, Limited, iron founders, North Ormesby, Middlesbrough.

The death is reported, at West Retford Hall, of Mr. Francis Huntsman, senior partner in the firm of Benjamin Huntsman, of Sheffield, steel manufacturers. Mr. Huntsman was descended from Benjamin Huntsman, of Attercliffe, the inventor of crucible cast steel. He was born in 1852, and was educated at Eton. A member of the Research Committee of the Sheffield University Technical Department, he was looked upon as one of the highest authorities in Sheffield on crucible steel.

Personal.

The late Mr. W. Hilton, vice-chairman of Platt Brothers, Limited, of Oldham, left estate of the gross value of £53,448, with net personalty £46,554.

Sir Robert Hadfield has been awarded by the Council of the Société d'Encouragement pour l'Industrie Nationale, Paris, with their grand gold medal for his valuable collective research work in metallurgical science.

The late Sir William Lloyd Wise, F.R.G.S., M.I.M.E., the founder and first president of the Chartered Institute of Patent Agents, left estate of the gross value of £36,522, with net personalty of £25,118.

Mr. H. S. Longsdon, son of Mr. H. C. Longsdon, chairman and managing director of W. Summerscales & Sons, Limited, Phœnix Foundry, and Coney Lane Works, Keighley, has been elected a director of the company.

Mr. A. Galbraith, who held a responsible position with the Glasgow and West of Scotland Technical College, has been appointed by the Cunard Line as an assistant to the superintendent engineer. Mr. Galbraith, after experience afloat, was engaged on the engineering staff of Messrs. Cammell, Laird & Company.

Mr. B. Firth, chairman of Thomas Firth & Sons, Limited, Sheffield, in which John Brown & Company, Limited, of Clydebank and Sheffield, hold a controlling interest, has completed a quarter of a century's service with the firm, and recently received from the staff and managers a presentation of Sheffield silver and an address.

Mr. Wilson Worsdell has decided to retire at the end of May next from the position of chief mechanical engineer to the North-Eastern Railway Company, and the directors have appointed him consulting mechanical engineer to the company as and from that date. Mr. Worsdell, we understand, will be succeeded by his present chief assistant, Mr. Vincent Litchfield Raven.

Mr. J. H. Fisher who has been elected a director of William Jessop & Sons, Limited, received an unusual compliment last month. He went straight from school to Jessop's works, taking a subordinate position in the offices. By his own hard work he rose to be works manager, and now has been appointed a director. The rest of the staff, regarding his appointment as a compliment to all the employés, expressed their congratulations by making a presentation to Mr. Fisher. The presentation was made at the annual staff dinner, the present comprising a silver tea and coffee service in case. Mr. Sydney Robinson (managing director) presided, and the company, numbering more than 70, included Colonel Hughes, C.M.G. (director), Mr. J. H. Fisher (director), Messrs. W. H. Thomas (works manager), W. J. Bailey (American department), Cedric Howell (secretary), E. Maidment (cashier), G. B. Moss, T. Jobson, R. Jackson, J. Smith, H. Houlder, T. Wood, J. Wood, B. Fidler, J Topham, B. Firth, F. Wardrobe, and G. Burton. The guests included Mr. Masakta Nakashine (of the Japanese Arsenal, Kure), Mr. F. C. Turpin (Lloyd's Surveyor), and Dr. Evans (U.S.A. Vice-Consul).

New Companies.

WATER-TUBE BOILER AND ENGINEERING COMPANY, LIMITED.—Capital £50,000 in £5 shares.

THOMAS PARKER, LIMITED.—Capital, £1,000 in £1 shares, to carry on the business of ironfounders, engineers, etc.

CHILIAN EXPORT COMPANY, LIMITED.—Capital £1,000 in £1 shares, to carry on the business of dealers in machinery, tools, etc.

MCLAREN BROTHERS, LIMITED.—Capital £11,000 in £5 shares, to carry on the business of engineers. Registered office: Sandpoint, Dumbarton.

PEARLITE STEEL COMPANY, LIMITED.—Capital £4,000 in £1 shares (2,000 preference), to acquire the business of the Pearlite Steel Company, Limited (in liquidation).

HOPYARD FOUNDRIES COMPANY, LIMITED.—Capital £2,000 in £1 shares, to carry on the business of malleable steel and iron founders, dealers in iron, etc.

MEXICAN MACHINERY COMPANY, LIMITED.—Capital £15,000 in £1 shares, to carry on the business of exporters of and dealers in textile and other machinery, etc.

ROTOPLUNGE PUMP COMPANY, LIMITED.—Capital £10,000 in £1 shares, to purchase, build, repair, acquire and improve the manufacture of rotary plunger or other pumps etc.

DORWALD ENGINEERING COMPANY.—Capital £2,000 in £1 shares, to carry on the business of ironmongers, engineers, etc. Registered office: 30 and 32, High Street, Wandsworth, S.W.

FOWLES & SONS, LIMITED.—Capital £3,000 in £1 shares, to carry on the business of manufacturers and dealers in fenders, fire-irons, etc. Registered office: 87, Cheapside, Birmingham.

BRITISH ELECTRO-METALLURGICAL PRODUCTS COMPANY, LIMITED.—Capital £100,000 in £1 shares (60,000 7 per cent. non-cumulative preferred ordinary). Registered office: 25, Victoria Street, Westminster, London, S.W.

HIGHTON & SON, LIMITED.—Capital £25,000 in £1 shares, to take over the business of a founder and engineer carried on by T. G. Highton at the Eagle Foundry and Works, London, as Highton & Company.

WOOD & ROBINSON, LIMITED.—Capital £3,000 in £1 shares (1,000 6 per cent. preference), to take over the business of Messrs. Wood & Robinson, engineers, machinists, and machinery brokers, etc., carried on at Neepsend Lane, Sheffield.

J. H. BUTLER, LIMITED.—Capital £10,000, in £1 shares, to take over the business of a stamper, piercer, and manufacturer of articles in wrought and cast iron, steel, brass, and other metals, etc., carried on by J. H. Butler at Wolverhampton.

ENGINEERS' SUPPLY COMPANY (OF MANCHESTER), LIMITED.—Capital £2,000 in £1 shares, to acquire the business carried on at Manchester by Beatrice Schuller as the Engineers' Supply Company. Registered office: 114, Princess Street, Manchester.

JONES & ATTWOOD, LIMITED.—Capital £40,000 in £1 shares (20,000 6 per cent. cumulative preference), to carry on the business of heating and general engineers, etc., and to acquire the business carried on at Titan Works, Stourbridge, as Jones & Attwood.

EDWIN SNOWDEN & COMPANY, LIMITED.—Capital £1,000 in £1 shares, to carry on the business of boiler manufacturers, still and tank makers, dealers in brass, iron and steel, ironfounders, etc. Registered office: Sculcoates Boiler Works, Fountain Road, Hull.

LONDON VERTICAL RETORT SYNDICATE, LIMITED.—Capital £2,000 in £10 shares, to acquire from T. M. Thom and H. Pryor the benefit of certain inventions relating to improvements in the manufacture of lime and carbonic acid gas, and in retort furnaces for the manufacture of gas.

JOSEPH WILLIAMSON & COMPANY, LIMITED.—Capital, £3,000 in £1 shares, to carry on the business of screwing machine makers, engineers and pattern makers, formerly carried on by J. Williamson, J. Hall, C. Blyth, J. Blyth. Registered office: Boslam Street, New Islington, Manchester.

MAXTED & KNOTT, LIMITED.—Capital £6,000 in £1 shares (4,000 5 per cent. cumulative preference), to adopt an agreement with G. V. Maxted and F. Knott, and to carry on the business of consulting and manufacturing engineers as formerly carried on by the said parties, and W. J. Coles, at Hull, as Maxted, Knott & Coles.

MCEWAN, PRATT & COMPANY, LIMITED.—Capital £30,000 in £1 shares, to take over the business of engineers and merchants carried on at 44, Devonshire Chambers, Bishopsgate Street Without, E.C., and at Wickford, Essex, as McEwan, Pratt & Company. Registered office: 44, Devonshire Chambers, Bishopsgate Street Without, London, E.C.

KEELING, TEALE, HARRIS & COMPANY, LIMITED.—Capital £4,125 in £1 shares (1,125 preference), to take over the business of a designer and manufacturer of wrought iron, bronze, brass, and other metalwork, carried on by H. J. Harris, as successor to Edgar Keeling, Teale & Company, Limited, Ravenscourt Square, Hammersmith, London. W.

RUSSIAN (SMIELOFF) CHAIN, ANCHOR AND TESTING WORKS, LIMITED.—Capital £250,000 in £1 shares, to enter into a contract with Luka Lukovitch Lotoff for the acquisition of certain works at Nijni Novgorod, Empire of Russia, and to carry on the business of iron and brass founders, makers and testers of chains, anchors, wire ropes and cables, etc.

EASTON & JOHNSON, LIMITED.—Capital £10,000 in £5 shares, to acquire the business carried on at Taunton by Easton & Bessemer, Limited, as Whitehall Iron Works, to adopt an agreement (1) between S. Tryson and W. Johnson, and (2) with W. Johnson, F. Harvey and W. W. Easton, and to carry on the business of ironfounders, engineers, tool makers, etc.

J. WILSON BROWNE & SON, LIMITED.—Capital £10,000, in £1 shares, to carry on the business of general merchants and factors, founders, coppersmiths, tin and wire workers, metal merchants, etc., to acquire the business carried on by W. P. W. Browne at Ludgate Hill, Birmingham, as J. Wilson Browne & Son, and to adopt an agreement with W. P. W. Browne, C. C. Bryan, and A. W. Browne.

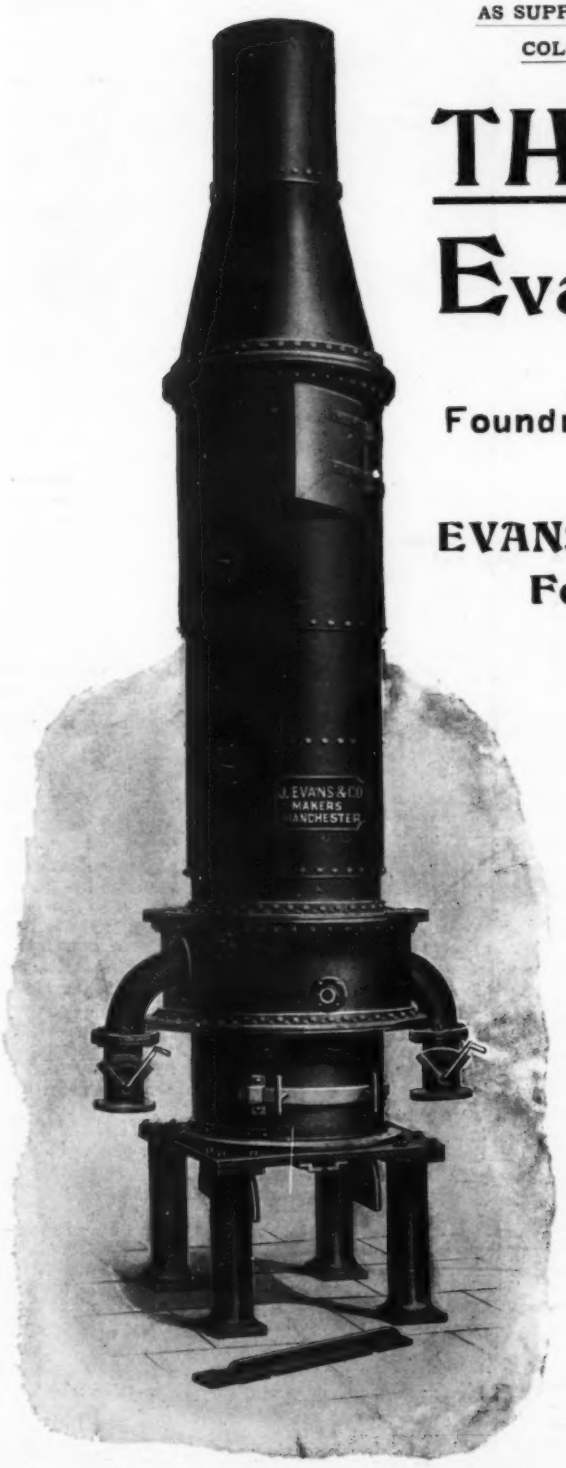
ALUMINIUM CORPORATION, LIMITED.—Capital £450,000 in 5,000 participating shares of 1s. each and 149,750 preference and 300,000 ordinary shares of £1 each, to acquire certain freehold lands, water rights, etc., referred to in an agreement with the Aluminium Corporation, Limited (incorporated in 1907), and R. Lawson and A. H. Gibson, the liquidators thereof, and to carry on the business of manufacturers of and dealers in aluminium, etc. Registered office: 34, Old Broad Street, E.C.

UNITED BRASSFOUNDERS AND ENGINEERS, LIMITED.—Capital £150,000 in £1 shares (10,000 adjustment, 46,666 preference, and 93,334 ordinary), to take over the businesses of engineers, coppersmiths, brass finishers, and general merchants carried on (1) by Isaac Storey & Sons, Limited, at Empress Foundry, Cornbrook, Lancashire; (2) by Gaukroger, Sykes & Roberts, Limited, at Ormskirk, Lancashire; (3) by Martineau, Beames & Madeley, Limited, at Holloway Head, Birmingham; and (4) by Newman, Hender & Company, Limited, at Dyehouse Works, Woodchester. Registered office:—35, Waterloo Street, Birmingham.

Limited Partnership.

E. WILLMOTT TAYLOR, chased casting and pattern makers, makers of dressed castings, brassfounders, designers and modellers for the bedstead, fender, art metal, and allied trades, 37, Fleet Street, Birmingham. Partnership for seven years from January 31, 1910. General partner, E. W. Taylor, 37, Fleet Street, Birmingham. Limited partner, C. H. Dunn, 220 Hagley Road, Birmingham, contributing £300 in cash.

AS SUPPLIED TO THE ADMIRALTY, WAR OFFICE,
COLONIES, AND FOREIGN GOVERNMENTS.



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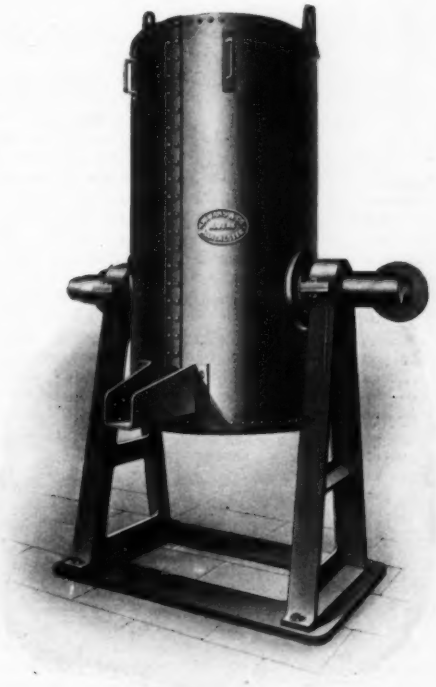
Evans's Rapid.

Foundries Completely Furnished.

EVANS'S NEW CUPOLETTE
For Emergency Work.



James Evans & Co.
Britannia Works,
Blackfriars,
MANCHESTER.

Telegrams: "LADLES, MANCHESTER."

Correspondence.

Locomotive Cylinders and Chemical Analysis.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—We have recently had the opportunity of analysing some borings from a pair of locomotive cylinders which have been in constant use on one of our English railways for twenty-three years, during which time they have only once been re-bored. We think this record will be admitted as a conclusive proof of the quality of the material employed in their manufacture. The analysis of the borings is as follows:—

	Per cent.
Combined carbon	1.215
Graphite	1.885
Manganese	0.360
Silicon	1.633
Sulphur...	0.219
Phosphorus	0.905

Such an analysis as this would be condemned by ninety-nine foundry chemists out of a hundred, and yet here we have proof that it has made cylinders which have stood the working test for twenty-three years, and after their present repairs (re-boring) may stand another twenty-three years. The engineer who submitted the borings to us states that the metal appeared to be hard, and of the old-fashioned kind, and adds that it cuts more like steel than iron.

There is nothing to be gained by discussing the analysis, since from a purely chemical point of view there are probably no records to show what would be the final effect of this particular combination of metalloids on cast iron, *i.e.*, very low carbon, medium silicon, very low manganese, very high sulphur, and high phosphorus. One general conclusion might, however, be drawn, and that is, that sulphur and phosphorus in far greater percentages than are usually allowed by chemists, are by no means necessarily destructive of the quality of cast iron for locomotive cylinder work. Our own opinion is that these elements may go very high in a low-carbon mixture; sulphur will promote hardness, and phosphorus fluidity and life during the pouring process, and hence density and fine surface in the casting. The fact is, as we have always recognised, that some irons and mixtures of irons are eminently suitable for cylinder work, by virtue of certain qualities which appear to be independent of their chemical composition, and these qualities must be in some way inherent in the ores from which the irons are smelted. This theory is constantly being substantiated in our own experience. We often come across cases where a founder working on a basis of analysis alone is getting but poor results with his cylinder castings, and where others who are taking certain irons and mixtures of the most unorthodox analysis, but which have a good record of success behind them for cylinder work, are getting sound and durable castings of the very highest class.

We venture to submit this matter to your notice, not only as one of general interest, but as one confirming the views we have so long expressed concerning mixtures for cylinder work. In connection with these we have always selected materials for our customers which have been chosen by us on the strength of their successful record in actual practice and of their observed physical qualities in the foundry and the functionating casting, rather than on fixed rules established by the chemist.

Yours, etc.,

THE FRODAIR IRON AND STEEL COMPANY, LIMITED.

Fenchurch House, London, E.C.

Queries.

Forged Bronze Spindles.

Can any reader inform us how to make forged bronze spindles for valves, or where we can obtain them?

"J. L. S."

Blast Pressure Gauges.

The writer wishes to know how he can measure the amount of air forced into the tuyere of a cupola by a fan or blower. What is meant by a pressure of 6 in. of water? Where can he procure a gauge to measure the blast? Perhaps some reader can give a sketch showing how to make a pressure gauge for this purpose. How many cubic feet of air should be forced in per cwt. of coke used or per ton of metal melted?

"FOUNDRYMAN."

Steel Moulder's Compo.

Could any reader give the composition of the compo. used by steel moulders? I might say that it is rather difficult here in South Wales to get crucibles to mix with the compo, as there is no crucible steel smelting done here as in Sheffield. Also, where is the French red sand obtained from for steel moulding?

"S. W."

Wood Screw Handles.

The writer desires to know where Dillon's patent wood screw handles (Patent No. 3,068) can be purchased?

"JOBBING FOUNDER."

MIXTURES FOR BRONZE GEARS.—Writing in "Castings," C. U. Prum gives the following mixtures as being suitable for bronze and brass gears:—A good manganese-brass gear is composed of copper, 55 lbs.; zinc, 36 lbs; tin, 5 ounces; and 80 per cent. ferro-manganese, 2 lbs. In making the alloy 15 lbs. of the copper are first melted with the ferro-manganese, which should be crushed to pea size. The metal will have to be strongly heated to melt the manganese. After it has been held at a white heat for fifteen minutes the balance of the copper may be added. Then the aluminum and tin are put in, and lastly the zinc. During the entire operation the metal should be covered with a good layer of charcoal. An even stronger alloy is made as follows: Take 53 lbs. of copper and add to it 6 lbs. of manganese zinc and 36 lbs. of bertha zinc, also 8 ozs. of silicon copper. The copper should be pure Lake copper. In making the mixture the copper is melted first, subsequently the manganese zinc introduced, then the silicon copper, and lastly the zinc. The manganese zinc may be made by melting 1 lb. of manganese copper with 2 lbs. of zinc. Another alloy known as Parsons white brass consists of zinc, 38 lbs.; tin, 60 lbs., and antimony, 2 lbs. It will be noted that this last alloy contains no copper whatever. An alloy which is sometimes used and which is more nearly a true bronze is composed of copper, 84 lbs.; tin, 10 lbs.; lead, 2 lbs.; and zinc, 4 lbs., the metals being introduced during the melting process in the order mentioned. A similar bronze comprises copper, 80 lbs.; tin, 10 lbs.; lead 2 lbs.; zinc, 2½ lbs.; yellow phosphorus, 5 ounces. The two last mentioned alloys are hard and fairly tough, but nevertheless will machine well. A softer alloy is of copper, 64 lbs.; tin, 4 lbs.; lead, 1½ lbs; zinc, 3½ lbs.

SOUND

STRONG, CLOSE-GRAINED

CASTINGS

Obtained by using

"TITANIUM THERMIT"

TINS READY FOR USE. **ALL SIZES from 2 cwt. to 20 tons.**

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Works: **210a, Bow Rd., E.**

ELDERS FOUNDRY COKE

AS SUPPLIED TO THE
BRITISH
ADMIRALTY DOCKYARDS.

The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.
We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blowholes and other defects, than we formerly did.

From BOW, McLACHLAN & CO., LTD. (Paisley Foundry), Paisley, Glasgow.

Paisley, 12th March, 1909.

We have yours of 4th inst., and in reply have pleasure in stating that we have been using your Foundry Coke for several years for special purposes with highly satisfactory results.

Elders Navigation Collieries, Ltd., Cardiff.

PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years:—

METALS.	End Feb., 1910.	End Feb., 1909.
Iron—Scotch pig warrants (ton	.... *57/1½	.... *53/1½
—Middlesbro' warrants .. ton	.... 51 3	.... 47 0
—W.C. Mines Bessemer ... ton	.... 66 0	.... 57 6
—Stock, Scotch ... ... tons	 1,000	 1,000
Copper—Chili bars, GMB ton	.... £59 5 0	.... £56 12 6
—Stock, Europe and afloat tons	 114,102	 52,239
Tin—English ingots ... ton	.... £150 10 0	.... £131 0 0
—Straits ... ... ton	.... £151 7 6	.... £131 10 0
—Stock, London, Holland, U.S.A., and afloat ...tons	.... —	 20,912
Lead—English pig ... ton	.... £13 15 0	.... £13 17 6
Spelter—Ord. Silesian ... ton	.... £23 3 9	.... £21 17 6
Quicksilver (75lb)... bottle	.... £9 10 0	.... £8 7 6
Antimony—Regulus ... ton	.... £30 0 0	.... £32 0 0

* Settlement price.

CASTINGS.

In the Cleveland district the following are the nominal rates current for castings:—

	£ s. d.		£ s. d.
Columns (plain)	6 10 0	to	6 15 0
Pipes, 1½ to 2½ in.	4 17 6	to	5 2 6
,, 3 to 4 in.	4 10 0	to	5 0 0
,, 5 to 8 in.	4 7 6	to	4 10 0
,, 10 to 16 in.	4 7 6	to	4 10 0
,, 18 to 24 in.	4 7 6	to	4 10 0
Chairs	3 10 0	to	3 12 6
Floor plates (open sand)	3 2 6	to	3 5 9

SCRAP.

The quotations for scrap, subject to market fluctuations, are as follows:—Heavy wrought (mixed), £2 9s. 0d.; light wrought, £1 7s. 6d.; heavy cast, £2 10s. 0d.; all per ton f.o.b., London. Copper (clean), £55 0s. 0d.; brass (clean), £39 0s. 0d.; lead (usual draft), £12 10s. 0d.; tea lead, £11 10s. 0d.; zinc, £19 0s. 0d.; all per ton delivered merchant's yard.

Electric Furnace Test.

In the electric furnace of the Acktiebolag Elektrometal design now in operation at the Domnarfvet Works, in Sweden, a series of tests have been made in the smelting of Tuollavaara ore from Lapland. These tests, which were carried out under the superintendence of Mr. J. Bergschold, engineer in charge, have been made the subject of a special report by Mr. Filip Freden, chief engineer, who witnessed them on behalf of the Starfors Acktiebolag. For the opportunity of reproducing the figures contained in this report, we are indebted to Mr. Jens Orten-Böving, of 72 and 74, Victoria Street, S.W., who represents the Acktiebolaget Electrometall in this country.

The ore showed the following analysis:—Fe_2O_3, 1.9 per cent.; Fe_3O_4, 93.5 per cent.; MnO, 0.1 per cent.; CaO, 0.6 per cent.; Al_2O_3, 2.0 per cent.; SiO_2, 1.8 per cent.; Fe, 68.9 per cent. The tests were carried on from June 26 to July 5 last. The total time occupied was 219 hours. During this time the current was turned off for 16 hours on account of defects in the machinery, change of an electrode, etc., leaving an actual smelting time of 203 hours. The charges were as follows:—

Tuollavaara ore.	Coke.	Charcoal.	Limestone.	No. of charges.
Kg.	Kg.	Kg.	Kg.	
100	11	11	4	149
100	12	11	4	181
100	8	15	4	156
100	8	17	4	56
100	7	17	4	75
		Total No. of charges ...		617

The total amount of material used was as follows:—Ore, 61.7 tons; limestone, 2.468 tons; coke, 6.032 tons; charcoal, 8,197 tons; electric energy, 112,109 kw.-hours, or 17 h.p.-years.

The output of pig-iron was 43.5 tons, with a carbon percentage varying from 2.33 to 3.09, and with a white structure. The percentage of iron to ore was 70.6.

Per ton of pig-iron there was used:—Electric energy, 0.39 h.p.-years; coke, 0.139 ton; total coal, 0.327 ton; charcoal, 0.188 ton. The coal used was of a rather poor quality, the tests showing percentages of carbon from 0.65 to 0.75 in the charcoal and 0.8 in the coke.

The pig-iron smelted per horse-power-year was 2.56 tons, and the production in twenty-four hours, 5.15 tons. The total amount of slag was about 7,000 kg., containing from 1.59 to 4.25 per cent. of iron. The average of the analysis made showed 2.95 per cent. The amount of iron in the slag thus was about $0.0295 \times 7{,}000 = 206.5$ kg., or 0.47 per cent. of the iron produced. Most of the iron in the slag was metallic.

The consumption of electrodes has been judged from the two electrodes last exchanged which had been in twenty-two and thirty days respectively. It was 9 kg. per ton of pig-iron. The average power used was about 550 kw., at a voltage of 44, and an amperage of 8,300, giving a power factor of 0.87.

NOTE.—In the above report, tons means metric tons, and h.p. means 0.746 kw.

GANISTER, CUPOLA BLOCKS, FIRE BRICKS,
FIRE CLAY.
Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.
STEEL MOULDERS' COMPOSITION, SILICA CEMENT.
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Established 1863.

JAS. DURRANS & SONS,

PHŒNIX WORKS, PENISTONE, Near Sheffield.

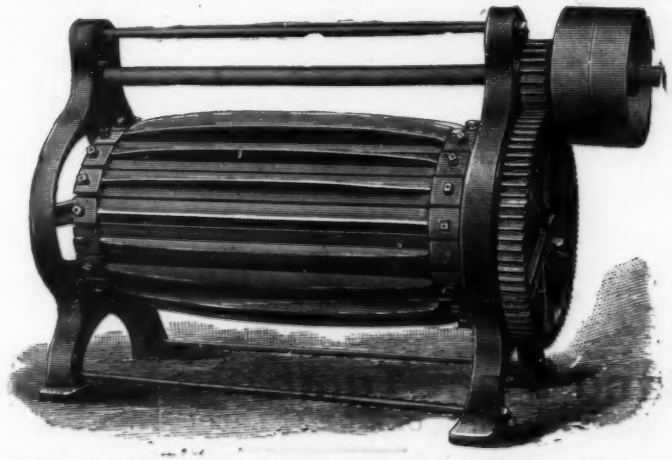
Manufacturers of all

FOUNDRY EQUIPMENTS,

COMPOSITION BLACK LEAD, PLUMBAGO, CORE GUM, WHITE DUST & COAL DUST.

Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, Etc.

IMPROVED FOUNDRY RATTLER or FETTLING DRUM.



These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

"Dear Sirs,—We have been using your best Blacking for a large number of years, and always use it on our large Ingot Moulds, which, as you know, we have made up to 85 tons in weight.

Yours faithfully, THE BRIGHTSIDE FOUNDRY & ENGINEERING CO., LD."

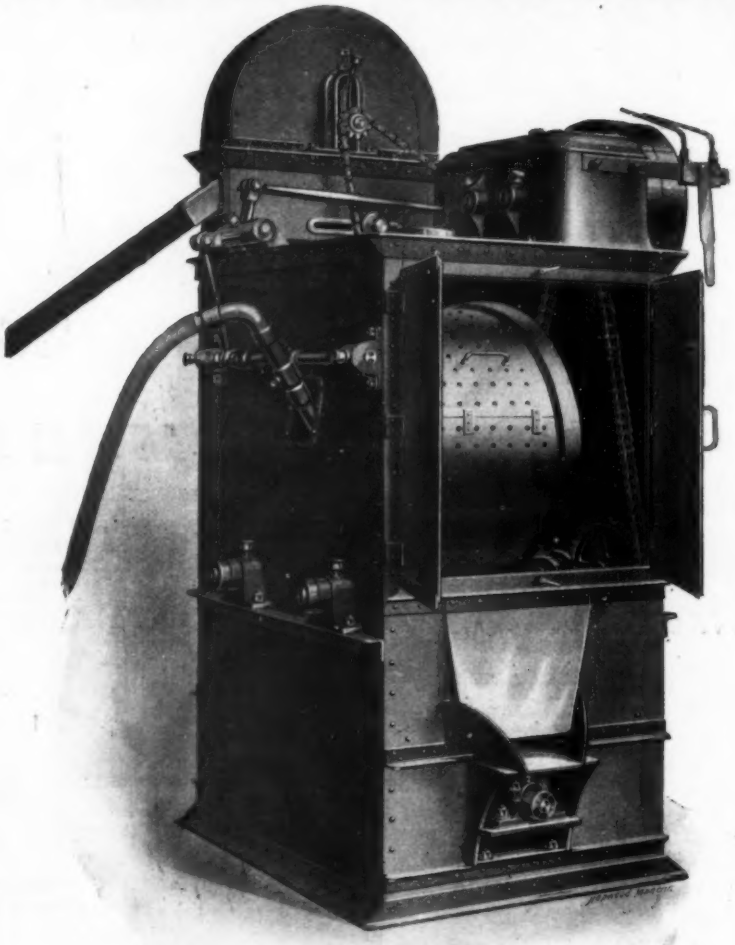
REDUCE YOUR CLEANING ROOM COSTS

BY USING

UP-TO-DATE

SAND-BLAST MACHINERY.

Give Castings better appearance.



Castings Machine quicker, Saves the machine tools.

Sand Blast Tumbling Barrel.

LARGE OUTPUT AT LOW COST.

MOULDING MACHINES, SAND PREPARING MACHINES.

THE LONDON EMERY WORKS Co. PARK TOTTENHAM. LONDON, N.

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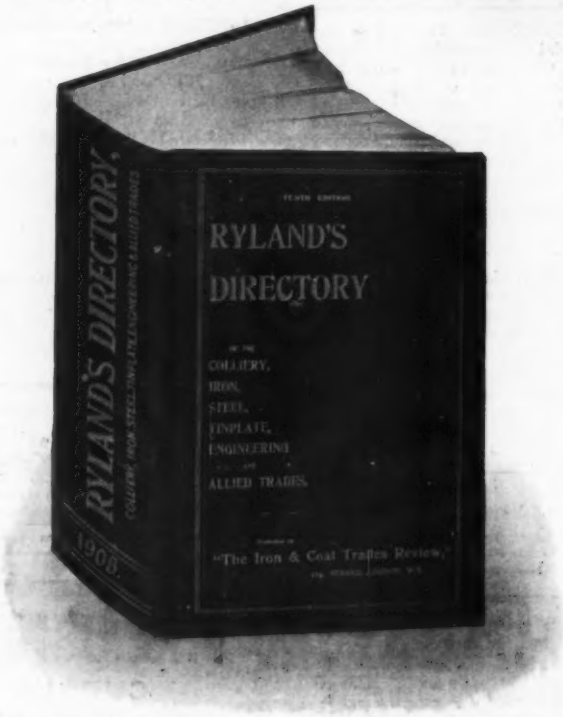

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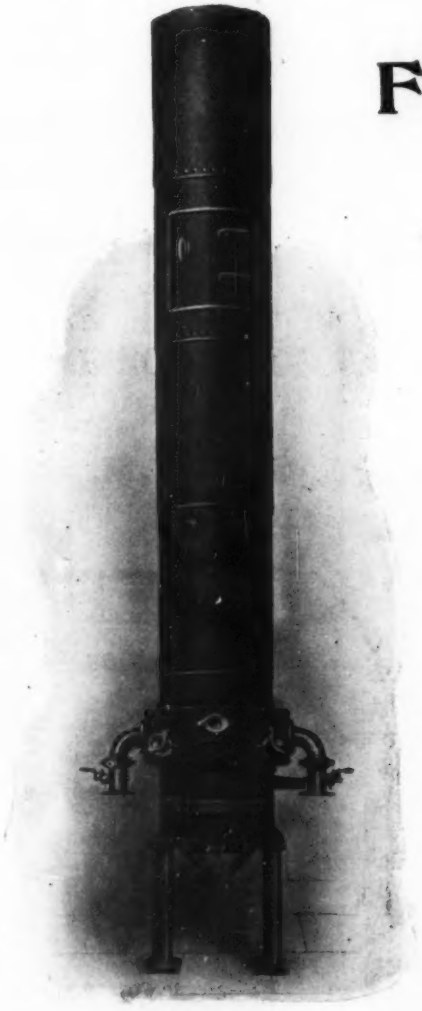

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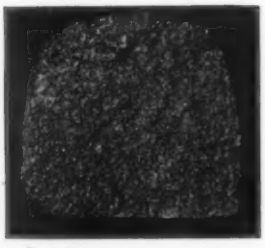
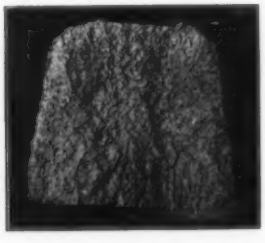

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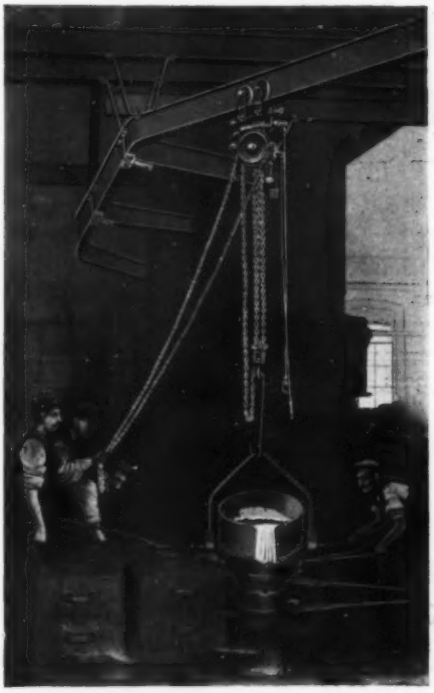

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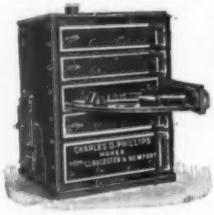

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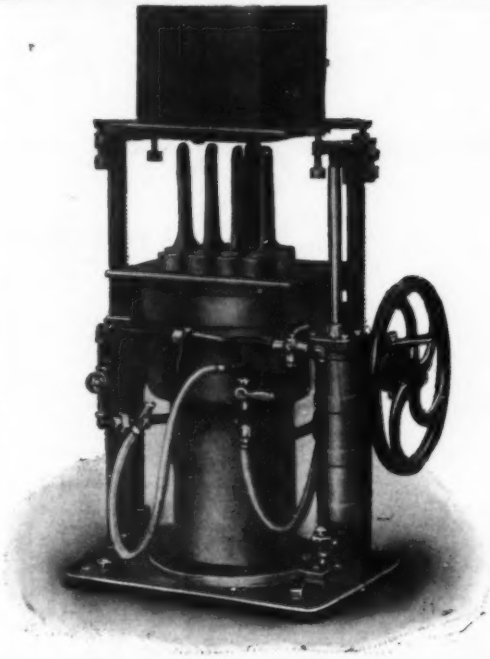

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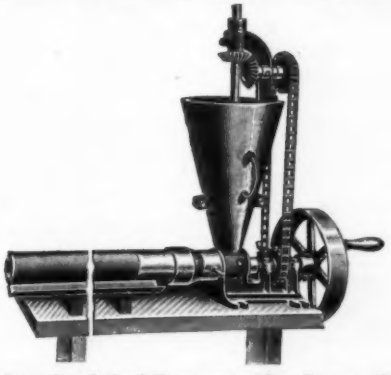

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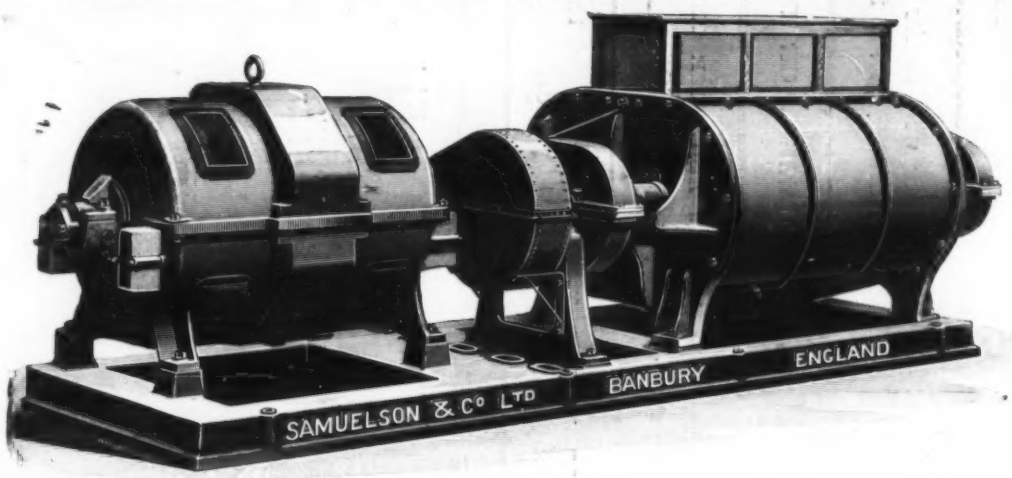

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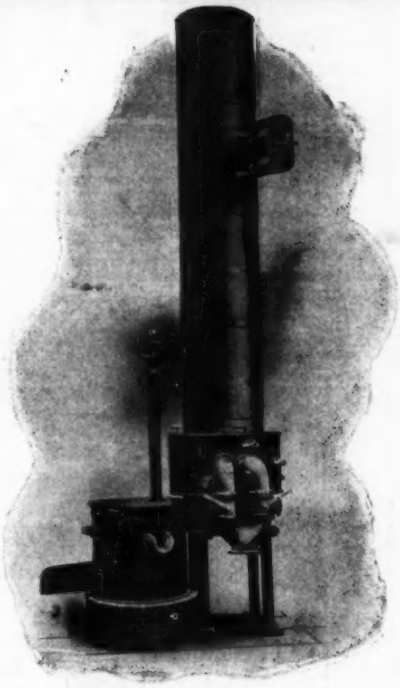

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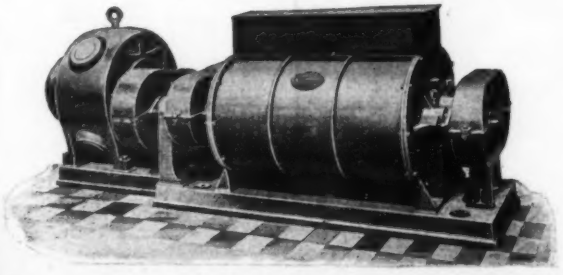

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